STUDIES ON RHIZOSPHERE AND RHIZOPLANE MYCOFLORA OF PIGEON PEA

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CERTIFICATE

This is to certify that Mr. Mohd. Atique Ahmad Khan has worked in this Department as a research scholar under my supervision and guidance. His work on "Studies on rhizosphere and rhizoplane mycoflora of pigeon pea" is uptodate and original. He is allowed to submit his thesis for the award of the degree of Doctor of Philosophy in Botany.

DPrakash

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C O N T E N T S

CHAPTER - I

INTRODUCTION

Hiltner (1904) in a land mark publication formulated the rhizosphere concept ("the zone of intensified microbial activity around the root zone") and presented the most convincing data that plant roots harbour a variety of micro-organisms. Perotti (1926) used the term 'edophosphere' for the rhizosphere of Hiltner and 'histosphere' for the root surface microflora. Clark (1949) coined the term 'rhizoplane' as an ecological niche or habitat provided for microorganisms by root surface. This interesting field of microbiology, however, remained neglected till 1929 apart from scattered investigations, which supported the observations of Hiltner. Starkey (1929 a,b and c) is credited for initiating detailed studies on rhizosphere. Since then, the rhizosphere concept has been critically examined from several angles. Appreciable amount of work has been done to find out both qualitative and quantitative nature of the rhizosphere and rhizoplane microflora. Doubts and scepticism concerning the importance of rhizosphere microflora in causing disease has been dispelled now. It has become axiomatic in plant pathology that rhizosphere microorganisms are largely associated with the occurrence of root-borne diseases. The subject matter on rhizosphere has subsequently been reviewed by several investigators (Smith, 1948; Katznelson et al., 1948; Clark, 1949; Lochhead, 1952; Starkey, 1958; Katznelson, 1961 and

1965; Rovira, 1965; and Parkinson, 1967).

A rhizosphere effect is discernible in the early stage of plant growth. Timonin (1940) noted the establishment of a rhizosphere microflora within three days of seed germination, more noticeable with bacteria than fungi. Further development of the rhizosphere population is dependent upon the normal growth of the plant. Starkey (1931), in his pioneering work on rhizosphere microorganisms of several agricultural plants, found consistently greater microbial numbers in the soil in the immense vicinity of the roots than soil away from the roots. Thom and Humfeld (1932) also observed that there were 40-70 times more fungi in the rhizosphere of corn plants than in the non-rhizosphere. Ishizava et al. (1957), Reddy (1959), Maliszewska and Moreau (1959); Ivarson and Katznelson (1960); Strzelczyk (1961), Rouatt and Katznelson (1961), Zagallo and Bollen (1962), Prakash (1967), Kulshreshtha (1969), Prakash et al. (1979), Ashraf (1981) and Ansari (1982), while studying the microbial population of different crops, confirmed more population in the rhizosphere in comparison to the non-rhizosphere. However, Padma and Mukerji (1972) in case of Rauwlfia serpentina Benth. ex Kurs and Yasmeen et al. (1982) in Allium sativum L. observed more fungal population in the non-rhizosphere in comparison to rhizosphere. They attributed it to toxic root exudates secreted by the plant.

A positive role of seed surface flora in root colonization was observed by Catska *et al*. (1960) and Dickinson and Pugh (1965 a,b). However, Peterson (1959) reported that fungi associated with seeds of barley, flax and wheat played little part in the colonization of roots in natural soils. Ranga Rao (1971) noticed that seed mycoflora did not play any specific role in root colonization.

Peterson (1959) pointed out that soil is apparently the primary source of fungi colonizing the roots of healthy plants. It is generally accepted that actively growing plant root exert a distinctive selective action on soil microorganisms resulting in the stimulation of certain groups and in the suppression of others. Mujumdar and Bhide (1970) observed in sugarcane rhizosphere that qualitative effect of rhizosphere on soil fungi persisted for 30 days even after harvest. Agnihothrudu *et al*. (1955) found that pigeon pea had a stimulative effect on *Melanospora brevirostrata* Moreau., *Aspergillus giganteus* Wehmer, and *Oedocephalum coprophilum* Kobayasi in its rhizosphere. Agnihothrudu (1957, 1958 and 1960) further noticed the effect of rhizosphere on *Rhizopus arrhizus* Fischer, *R. nodosus* Namys, *Choanephora cucurbitarum* (Berk & Ray) Thaxt., 16 ascomycetes and 50 imperfect fungi excluding penicillia.

Age of the plant profoundly influences the rhizosphere mycoflora qualitatively as well as quantitatively. Krassilnikov *et al*. (1936) reported first rise in the population of microorganisms during the early growth period and second at the time of formation of fruits. Riviere (1959) observed that the rhizosphere activity of wheat reached a distinctive peak at the tillering stage and the stimulation of fungi was greater than that of actinomycetes and bacteria. Rao (1962) found a higher rhizosphere population at the time of flowering, and a second increase was recorded at senescens. Agnihothrudu (1953) observed a decline in fungal numbers upto the time of flowering in certain crop plants of South India, afterwards an increase was noticed. An increase in the fungal population of the cluster bean rhizosphere upto harvest was recorded by Bahadur and Sinha (1965). Khasanov (1967) observed, in the rhizosphere of Hibiscus canabinus L., that the population of fungi increased from 2 leaf stage upto flowering and then decreased. Gujrati (1969) observed that the fungal population of the rhizosphere of lentil and gram increased from seedling stage and was maximum at flowering and fruiting, then decreased and rose again at the senescens stage. Rao and Mukerji (1971) observed that in four cultivars of rice the peak rhizosphere population reached at different stages of plant growth. Luke and Devi (1975) observed no significant effect of age on fungal population.

Studies on the nature of root exudates indicate that a wide range of substances are exuded by the roots. The subject matter has been reviewed by Rovira (1962, 1965 and 1969), Seroth and Hilderbrand (1964) and Wood (1960). The first conclusive evidence of excretion of exudates from roots was provied by Knudson (1920), who demonstrated that peas and maize, grown under aseptic conditions in sucrose solution, produced considerable quantity of reducing sugars. Knudson observed that sucrose was absorbed by the roots and converted into reducing sugars which were excreted. Lyon and Wilson (1921) indicated that organic nitrogen was released from maize roots growing under sterile conditions. West (1939) observed that flax seedlings grown in sterile solution excreted significant quantities of vitamins (thiamine and biotin). Lundegardh and Stenlid (1944) have recorded that glucose, flavonones and nucleotides were excreted by roots of wheat while glucose and nucleotides by peas. Presence of large number of nucleic acid in the excretions of germinating pea seeds was reported by Fries and Forsman (1951). Katznelson <u>et al</u>. (1954) reported the excretion of amino acids and a reducing sugar, similar to that of glucose, from the roots of tomato, soybean, barley and oats. Rovira (1956a) reported 22 amino acids from the root excretions of pea. Andal <u>et al</u>. (1956) reported that four amino acids viz., aspartic acid, glutamic acid, tryptophane and lysine were excreted from roots of rice plants both susceptible and resistant to root rot caused by <u>Fusarium moniliforme</u> Sheldon. Four other amino acids cysteine, methionine, asparagine and tyrosine were present only in the root exudates of resistant variety. Bhuvaneshwari and Subba Rao (1957) identified several organic acids and sugars from the root exudates of *Sorghum vulgare* Pers. and *Brassica juncea* Czern. Roy and Dwivedi (1967) listed leucine, methionine, alanine, glutamic acid, aspartic acid, cystine, phenylalanine, arginine (amino acids), rhamnose, arabinose, glucose, fructose, sucrose and raffinose (sugars), as the constituents of root exudates of some leguminous crops. Bhuvaneshwari and Sulochna (1955), Sulochna (1958) and Rovira and Harris (1961) showed by bio-assay technique that root exudates contain biotin. Vancura (1964) and Vancura and Hovadik (1965) observed quantitative and qualitative differences in the composition of root exudates of six plants viz., barley, wheat, cucumber, turnip, cabbage, tomato and red pepper in the initial stages of growth. Vrany *et al*. (1962) observed large number of organic acids, amino acids, antibiotics and sugars in the root exudates of wheat. Papavizas and Kovacs (1972) extracted 0.6, 0.482 and 0.55 μg/plant palmitic, stearic and oleic acid respectively, from bean (*Phaseolus vulgaris* L.) plants growing aseptically in sand solution cultures; while no fatty acid was detected after 8 days in liquid culture. The first conclusive evidence of the stimulation of specific organism by root exudates was that of O'Brien and Prentice (1930), showing that cyst of potato eelworm (*Heterodera rostochiensis* Woll.) hatched only in the presence of root washing of potato and not in that of beet, rape, lupin, mustard and oat roots.

The root excretions have been found to have significant influence on the germination of fungal spores. Barton (1957) observed that oospores of Pythium mamillatum Merrs. germinated only when placed in soil before growing turnip seedlings, however, there was no germination in non-rhizosphere and distilled water. Roy and Dwivedi (1967) found complete inhibition of conidial germination of Helminthosporium sativum Pammel, King and Bakke and Fusarium culmorum (Smith) Sacc. on glass slides in unsterilized soil but majority of conidia germinated when wheat seedlings were grown on slides. Youssef and Mankarios (1969) found that root exudates of broad bean and cotton stimulated spore germination and growth of rhizosphere fungi. Srivastava (1973) demonstrated a direct relationship between rhizosphere microflora and amino acids in the root exudates and root extract of Echinochloa crus-galli Beauv. and Paspalum scorbiculatum. Sullia (1973) studied the effect of root exudates and root extracts of Cassia tora L. and Crotalaria medicaginea D.C. on some dominant rhizosphere fungi and observed that root extracts induced a higher degree of stimulation in rate of growth of fungi tested, while root exudates caused only a marginal effect, which was positive on all fungi except Trichoderma lignorum (Tode) Harz. Karimbaeva and Sizova (1977) observed that the growth and development of fungi depended on the concentration of root exudates.

Mounting interest has been directed to the effect of foliar sprays of chemicals on the soil microflora. Halleck and Cochrane (1950) were the first to consider this problem. They noticed quantitative changes in the rhizosphere flora by the application of various fungicides. Ramachandra Reddy (1959 and 1968) noticed that Penicillia around rice roots were stimulated by urea sprays, while higher concentration of urea inhibited Penicillia and stimulated Aspergilli. Venkata Ram (1960) recorded an increase in the fungal population as a result of foliar application of nutrients. Rangaswamy and Vasantharajan (1961) studied the influence of streptomycin spray on rhizosphere microflora of citrus plants. Horst and Herr (1962) observed that, in the rhizosphere of corn seedlings, the number of actinomycetes antagonistic to Fusarium roseum f. cerealis Snyder & Hansen increased with the foliar spray of urea. Vrany et al. (1962) noticed that root exudates and rhizosphere microflora could be altered by spraying leaves with inorganic phosphate, antibiotics, growth regulators and urea. Vrany (1963) reported pronounced decrease in the number of fungi in the wheat rhizosphere as a result of foliar spray with urea. Agnihotri (1964) observed that in wheat rhizosphere out of 16 Aspergillus spp. - A. nidulans (Eidam) Winter, A. sydowi (Bainer & Sartory) Thom & Church, A. fumigatus Fres ., A. niger van Tieghem and A. flavus Link increased with increasing number of foliar sprays of urea and in the root exudates amino acids, particularly glutamine and α-amino butyric acid increased and organic acids decreased. Roy and Dwivedi (1967) reported that foliar spray of some hormones like indole acetic acid and 3-yl-propionic acid resulted in an increase of rhizosphere population. Kundaswamy and Rangaswamy (1967) studied the effect of foliar nutrient sprays on the rhizosphere microflora of sorghum. Ramachandra Reddy (1968) studied the effect of foliar application of certain trace elements and metallic chelates on rhizosphere microflora of rice (*Oryza sativa* L.). Swaminathan and Sullia (1969) recorded that spraying with pesticides decreased the bacterial population in the rhizosphere, on the other hand fungal population remained unaffected. Sullia (1969) studied the effect of foliar spray of Kitazin (fungicide) on rice var. CO.18 and recorded low fungal population in comparison to control. Sullia (1968), Gujrati (1969) and Singh (1970) observed that rhizosphere fungal population of gram, leguminous weeds and *Argemone maxicana* L. increased as a result of foliar application with hormones. Balsubramanian *et al.* (1970) studied the influence of foliar application of chemicals on the rhizosphere microflora of *Eleusine coracana* L. Dwivedi and Singh (1971) recorded that foliar spray of 50 ppm concentration of gibberellic acid increased the fungal population, while 100 and 200 ppm showed inhibitory effect, maleic hydrazide had inhibitory effect at all concentrations. Srivastava and Mishra (1971) recorded that fungal population in the rhizosphere of wheat was reduced by foliar application of tafasan, biizon and streptomycin. Gupta (1971) observed that foliar spray of gibberellic acid caused significant changes in the rhizosphere fungal population of Datura alba Nees, Ocimum sanctum L. Mant. and Withania somnifera Dun. Ranga Rao et al. (1972) noticed that rhizosphere fungal population decreased as a result of spraying with higher concentration of morphactin. Vrany (1972) found in artificially contaminated soil with Fusarium spp. that leaf application of 1.2% urea solution to wheat resulted in more mycolytic bacteria and fewer fungi on the roots. Vaidehi (1973) observed that as a result of urea spray number of microorganisms including antagonistic actinomycetes increased in the rhizosphere of wheat. Balsubramanian and Rangaswami (1973) found that application of Dithane Z-78 (200 ppm) reduced amino acid exudation in Sorghum vulgare Pers. and Crotalaria juncea L., caused qualitative changes in sugars and considerably reduced the rhizosphere population. Gupta (1974) studied the effect of an antibiotic subamycin (tetracycline compound) on the rhizosphere and rhizoplane mycoflora of Trigonella foenum-graceum L. and observed that lower concentration increased the fungal population. Srivastava and Dayal (1981) studied the effect of fungicidal spray on the rhizosphere and rhizoplane mycoflora of *Abelmoschus esculentus* (L.) Moench and noticed that fungicidal sprays with eight fungicides viz., Bordeaux mixture, Dithane M-45, Dithane Z-78, Miltox, Zincop, Ziram, Vitavax and Aureofungin reduced the fungal population in rhizosphere and rhizoplane. Maximum reduction was noticed in Aureofungin followed by vitavax. Bagyaraj and Rangaswami (1982) studied the rhizosphere microflora of *Eleusine coracana* (L.) Gaertn. in relation to foliar spray with chemicals in presence and absence of pathogen-*Helminthosporium nodulosum* Burk. & Curt., and observed that due to foliar sprays with chemicals (ammonium sulphate and 2-4D) the population of fungi and actinomycetes in the rhizosphere increased.

Ample work has been conducted to modify the rhizosphere microflora by soil treatments. Clark and Thom (1939) reported that rhizosphere population responded favourably to organic manuring. Mosolov *et al.* (1959) found increased counts both in rhizosphere and non-rhizosphere with NPK fertilizers. Gadzhieva (1959) claimed that organo-mineral treatments increased counts in the root zone of winter wheat. Davey and Papavizas (1959 and 1960) noticed that addition of organic materials subsequently increased the total number of fungi and streptomycetes in the rhizosphere of beans and suppressed the *Rhizoctonia* disease. Papavizas and Davey

(1961) working with rhizosphere mycoflora of lupin observed no significant difference in response to corn stover with or without NH_4NO_3. A detailed study of individual fungi in the rhizoplane was claimed to show a preferential effect on species of _Penicillium_ and _Mortierella_, yet the count of _Penicillia_ went up from 88 to 854 (a 6.6 fold increase) with corn stover, but some soil counts went up from 53 to 334 (6.2 fold increase). Samtsevich and Borisova (1961) reported that, in pot experiments, mineral and organic fertilizer had little effect on counts in uncropped soil or in wheat rhizosphere, but in field experiments the effect of fertilizers depended on the time of the year. Venkatesan (1962) showed that addition of green leaf and farm-yard manures to rice adversely affected the R:S ratio for first 45 days after which R:S ratio increased. Papavizas (1963) showed that incorporation of grounded mature straw enriched with ammonium nitrate increased the number of bean rhizosphere antagonistic to _Fusarium solani_ f. _phaseoli_ (Burk.) Snyder & Hansen, _Rhizoctonia solani_ Kuhn, _Thielaviopsis basicola_ Zopf and _Verticillium albo-atrum_ Reinke & Berth. Baker and Nash (1965) found that amendment of cellulose or NH_4NO_3 had no significant effect on the density of _Fusarium solani_ f.sp. _phaseoli_ (Burk.) Snyder & Hansen in bean (_Phaseolus vulgaris_ L.) rhizosphere. Absalyamova (1963) reported that application of organo-mineral mixtures greatly increased the total number of bacteria in the rhizosphere of maize, beet and winter wheat.

O'Rourke and Miller (1966) found that K fertilizers decreased the root rot and the recovery of Fusarium spp. from roots and rhizosphere of alfalfa plants. Bagyaraj and Rangaswami (1967) reported that application of fertilizers reduced the rhizosphere population. Sunar and Chohan (1971) studied the effect of gypsum and groundnut cake amendments on Rhizoctonia solani Kuhn, R. bataticola (Taub.) Butler, Macrophomina phaseoli, Trichoderma viride Pers. ex Fr. and T. polysporum in the rhizosphere of 30, 45 and 60 days old groundnut plants uninoculated and inoculated with R. solani or M. phaseoli. Srivastava and Sinha (1971) observed reduction in wilt of coriander (Coriandrum sativum L.) caused by Fusarium oxysporum f. sp. coriandarii Narula & Joshi by amendment with oil cake more effectively than organic manures. Mishra (1972) observed that addition of superphosphate stimulated the rhizosphere mycoflora of rice (Oryza sativa L.). Jorden et al. (1972) demonstrated that saprophytic activity of Verticillium dahliae Kleb. was inhibited by soil amendments with chitin, laminarin, wheat straw and oven dried green clover. Chitin and laminarin gave a significant decrease in the number of viable propagules counted in soil and disease severity. Jalaluddin (1975) reported higher fungal and bacterial population from the rhizosphere of rice as a result of application of fertilizers. Kirmani and Alam (1975) demonstrated that frequency of most of the fungi in the rhizosphere of cabbage remianed unaffected by C/N ratios of soil. The relative abundance of saprophytic fungi increased with a corresponding decrease in the parasitic forms. Khanna and Singh (1975) found a higher fungal population in amended rhizosphere soil. Ashraf (1981) noted higher fungal population and more frequency in the rhizosphere and rhizoplane of _Triticale hexaploide_ Lart. and _Pennisetum typhoides_ (Burm.f.) Stapf & Hubbard as well as in non-rhizosphere due to soil amendment with urea, bone meal and oil cakes. On the other hand, Katznelson _et al_. (1959), Voroshilova (1956) and Lochhead (1959) reported that rhizosphere population was not affected by soil amendments. Inhibitory effect on soil microorganisms as a result of application of nematicides, pesticides, herbicides have been reported by Bollen _et al_. (1954), Bollen (1961), Lebed (1964), Tu (1972 and 1973), Singh and Prasad (1973), Midha and Nandwana (1974), Rodriguez-Kabana and Adams (1975) and Jain and Sehgal (1980). Vaartaja and Agnihotri (1970) observed that fumigation with methyl bromide alone or in combination with captan increased bacteria and reduced moulds and actinomycetes in the rhizosphere of spruce, whereas captan alone increased moulds particularly _Penicillium janthinellum_ Biourge and _Gliocladium_, _Mortierella_ sp. and _Trichoderma viride_ Pers. ex Fr.; _Fusarium_ spp. increased slightly but _F. solani_ (Mart.) Sacc. was reduced by both fungitoxicants. Pathogenic fungi were eliminated; however, no significant effect was noticed on total mycorhizal percentage. Bertoldi *et al.* (1977 and 1978) recorded that in the rhizosphere of onion plants the amendment of captan and benomyl inhibited rhizosphere fungi. Peno *et al.* (1977) reported that methyl bromide was fungicidal to pathogenic, saprophytic and mycorrhizal fungi around *Pinus* spp. seedlings.

The intense microbial activity in the rhizosphere has direct or indirect effect on plant pathogen and vice versa. The major composition of rhizosphere population consists of non-pathogenic organisms. Hence, it seems that pathogenic organisms have to face this barrier inorder to initiate infection. In many cases the resistance and susceptibility between the different varieties of single plant species were linked with the microflora of rhizosphere. Timonin (1940) observed that varieties of flax, susceptible to wilt caused by *Fusarium oxysporum* f. *lini* (Bolley) Snyder & Hans. and tobacco varieties susceptible to *Thielaviopsis basicola* Zopf (root rot), were known to support a greater number of microorganisms than the resistant varieties. Lochhead *et al.* (1940) also found in his studies that susceptible varieties exerted greater rhizosphere effect than the resistant ones. Timonin (1941) observed that in varieties of flax susceptible to wilt, fungal species of *Alternaria*, *Cephalosporium*, *Fusarium*, *Helminthosporium* were more abundant than the resistant varieities. Reynolds (1926) observed a direct correlation between resistance of flax varieties to *Fusarium lini* Bolley and the recovery of hydrocyanic acid from plant tissues. Timonin (1947) found that varieties of oat susceptible to manganese deficiency harboured in its rhizosphere a denser population of manganese-oxidising, caesin-hydrolysing and denitrifying bateria in comparison to resistant variety . Winter and Rumker (1949) concluded that resistance of maize and wheat to *Ascochyta pinodella* Jones and *Fusarium culmorum* (Smith)Saccardo was mostly conditioned by rhizosphere microflora. Harper (1950) found a higher population of microorganisms in susceptible varieties of banana in comparison to resistant varieties. Naim *et al.* (1957) compared 3 varieties of cotton viz. Ashmouni (highly resistant to *Fusarium oxysporum* Schlecht), Karnak and Giza-26 (both exhibiting varying degree of susceptibility) with that surrounding soil (20 cm apart from the root). With Ashmouni there was significant higher R:S ratio for total bacteria, total simple nutritional form of bacteria and total fungi. The rhizosphere of Ashmouni had the highest population of *Bacillus subtilis/licheniformes* (antagonistic) group and lowest of *B. megaterium*, while with Giza-26 the reverse was observed. Buxton (1957) found that germination of conidia of a particular race of *Fusarium oxysporum* f. *pisi* Linford decreased by water extracts from rhizosphere of a resistant cultivar of pea-Alaska or Delwinche Commando and increased in that of susceptible cultivar – Onward, exception being race 3 spores which germinated poorly in rhizosphere extract of Alaska (susceptible to the race). Sulochna (1958) made quantitative studies of rhizosphere flora of two genetic strains of two species of cotton (the diploid susceptible variety of *Gossypium arborium* race *indicum* Linn. and tetraploid resistant *G. hirsutum* Linn.), and obtained interesting results about nature of root exudates and their role on the activity of plant pathogens. Lacy and Horner (1962) recorded that 4 week population of microsclerotial isolates of *Verticillium albo-atrum* Reinke & Berth in the rhizosphere of resistant *Mentha crispa* L. was less than in the susceptible *M. piperata* Stokes and *M. spicata* L. Strzelczyk (1964) observed that rhizosphere of susceptible varieties harboured greater number of microorganisms than resistant varieties. Peterson and Rouatt (1967) found that flax variety susceptible to *Fusarium oxysporum* f. *lini* (Bolley) Snyder & Hansen had more profuse and metabolically active bacterial rhizosphere flora than resistant variety. Horny and Ullstrup (1967) found that in maize susceptible varieties to root rot harboured larger population of fungi in the rhizosphere than resistant ones. Avezdzhanova *et al.* (1974) found that cotton variety C-6030 (tolerant to wilt) had highest population of microorganisms lowest with the susceptible 108-F and intermediate with the Tashkent-1. Ito and Ui (1975) reported that chlamydospores of the fungus *Fusarium solani* f. sp. *phaseoli* (Burk.) Snyder & Hansen germinated in both the rhizosphere of susceptible bean and non-susceptible broad bean. Srivastava and Mishra (1972) encountered more fungal population in the rhizosphere of wheat susceptible variety to *Puccinia graminis* var. (f.sp.) *tritici* (Pers.) Eriks & Heun. in comparison to resistant variety. Khan *et al.* (1973) observed higher frequency and relative abundance of parasitic form like *Rhizoctonia solani* Kuhn and *Fusarium* spp. in the rhizosphere and rhizoplane of cauliflower cv. Snowball in comparison to resistant (Snowball Elite). Parlik (1950) found that *Aspergillus glaucus* Link and related species predominates in the sterile soil and *Fusarium lini* Bolley and *Penicillium* sp. in infested soil (flax seedlings infected with *F. lini*); *Penicillium* sp. multiplied in the rhizosphere of infected plants, however, saprophytic bacteria and fungi markedly reduced. Rumker (1951) observed that in the case of *Ascochyta pinodella* Jones and *Fusarium culmorum* (W.G. Smith) Sacc. pathogens of garden pea, maize, wheat and colza, the root resistance of these two pathogens was to be conditioned by the microflora of rhizosphere and also by infection - repellent principles residing in the root itself. Agnihothrudu (1959), while studying the rhizosphere microflora of tea in relation to charcoal stump rot caused by *Ustalina zonata* (Lev.) Sacc., reported that there was enormous differences in the density of the fungi and bacteria in rhizosphere flora of apparently healthy and infected ones.

A great variety of species of fungi were recorded in the rhizosphere of diseased plants. Timonin (1966) recorded that rhizosphere of diseased _Pinus contorta_ var. _latifolia_ harboured more rhizosphere population in comparison to their healthy counterparts. _Aspergillus_, _Phoma_, _Pythium_ and _Rhizoctonia_ spp. were restricted to diseased plants, while _Alternaria_, _Cephalosporium_, _Metarrhizium_, _Spicaria_ and _Tilachlidium_ spp. to healthy plants. Lacy and Horner (1966) reported that although _Verticillium dahliae_ Kleb. increased more in the rhizosphere of susceptible and resistant _Mentha_ spp., significant increase in population also occurred in the rhizosphere of immune wheat and maize. Chatopadhyay and Mukhopadhyay (1967) recorded higher rhizosphere population in healthy rice plants in comparison to their infected counterparts. Pettit (1967) found that root disease of _Lotus corniculatus_ L. was reduced sometimes by the presence of some othor fungi in the inoculum. Srinivasan (1968) observed that in the mixed culture of CO-419 (susceptible) and CO-453 (resistant) to _Pythium graminicolum_ Subram., the susceptibility of CO-419 was reduced while that of resistance of CO-453 maintained. The number of bacteria, actinomycetes and fungi increased in the rhizosphere under the condition of mixed culture as compared to uniculture. CO-419 became resistant to root-root under the influence of mixed culture only in the presence of fungal component of the rhizosphere and not with bacteria and actinomycetes alone. CO-453, however, owed its resistance to its individual actinomycetes as well to as its fungal flora. Khare (1968) recorded that the rhizosphere of diseased strawberry plants harboured more fungal population in comparison to their healthy counterparts. Vishwanath et al. (1969) reported that soil and rhizosphere microbial population was altered both quantitatively and qualitatively around diseased plants of coffee (decline disease). Powell (1969) observed that *Trichoderma* sp. exhibited higher frequency in healthy plants and not in infected ones. Hong (1969) reported that concomitant inoculation of *Fusarium oxysporum* f. sp. *cucumerinum* Owen with rhizosphere fungi delayed damping off. Mathur and Chauhan (1972) studied the rhizosphere of gram inoculated with *Fusarium oxysporum* f. sp. *ciceri* Matuo & Sato, *Rhizoctonia solani* Kuhn and *Sclerotium rolfsii* Sacc. Different rhizosphere conditions developed with each pathogen but a higher population of microorganisms was always encountered in diseased plants in comparison to healthy counterparts. Babushkina (1973) reported that cotton plants infected with *Verticillium dahliae* Kleb. harboured more fungi in comparison to healthy plants. Sharma and Sinha (1974) studied the rhizosphere and rhizoplane mycoflora of linseeds grown in the soil infested with *Fusarium oxysporum* f.sp. *lini* (Bolley) Snyder & Hansen type 24 at different stages of growth and also determined the effect of root exudates. Mukhopadhyay and Nandi (1974) reported differences between healthy jute plants and plants infected with *Macrophomina* phaseoli (Maubl.) Ashby. Stefurak (1976) recorded a sharp decrease in the population of microorganisms in the rhizosphere of spruce infected with Fomitopsis annosa Karst. (Heterobasidium annosum) in comparison to their healthy counterparts. Rai and Upadhyay (1980) observed that pigeon pea plants infected with Fusarium udum Butler harboured more population of microorganisms in the rhizosphere in comparison to the healthy counterparts.

Rhizosphere studies have been carried out on different crop plants in India and abroad. Thom and Humfeld (1932) studied the rhizosphere mycoflora of alfalfa, rye, vetch and corn; Krassilnikov et al. (1933) of pea nuts; Obraztzova (1935) of tea bush; Simmonds and Ledingham (1937) of wheat; Clark and Thom (1939) of cotton and wheat; Timonin (1940 a and b) of wheat, oats, alfalfa and peas; Berezova (1941) of flax; Katznelson and Richardson (1948) of strawberry; Atkinson and Robinson (1955) of potato; Ishizawa et al. (1957) of barley, timothy and alfalfa; Herr (1957) of corn, oats and wheat; Warcup (1957) of wheat; Peterson (1958) of wheat and red clover; Stenton (1958) of pea; Chester and Parkinson (1959) of oat; Catska et al. (1960) of wheat; Ivarson and Katznelson (1960) of yellow birch; Moskovets and Zhdanova (1960) of maize; Parkinson and Clark (1961) of onion; Goos and Timonin (1962) of banana; Rouatt et al. (1963) of soybeans; Vancura and Hovadik (1965) of barley, wheat, cucumber, turnip, cabbage, tomato and red pepper; Kirilenko and Moskovets (1969) of wheat, oats, barley and maize; Hong (1969) of cucumber; Robinson (1970) of sugarcane; Neal *et al.* (1970) of wheat; Kirilenko (1971) of barley and oat; Todorovic *et al.* (1972) of maize; Fenwick (1973) of onion; Kirilenko (1973) of barley and oat; Youssef and Mankarios (1974) of broad bean and cotton; Krivets (1975) of lupin; Ito and Ui (1975) of bean; Stefurak (1976) of spruce; Chrzanowski (1976) of wheat; Karimbaeva and Sizova (1976) of pine, spruce, birch and oak; Hornby and Brown (1977) of wheat; Peno *et al.* (1977) of pine; Smiley (1978) of wheat; Bertoldi *et al.* (1978) of garlic; Ali *et al.* (1979) of citrus, pomegranate, grapevine and date palm; Odunfa and Oso (1979) of cowpea; El-Hissy *et al.* (1980) of sunflower, chrysanthemum, *Nigella sativa*, *Datura inoxia* and *Hyosymus muticus*.

In India Agnihothrudu (1953) studied the rhizosphere mycoflora of pigeon pea, cluster bean, cotton, sorghum, sesame, french bean and sunnhemp; Patel and Iyer (1961) of cotton; Rangaswamy and Vasantharajan (1962) of citrus; Sondhi and Sinha (1963) of gram; Bahadur and Sinha (1965) of cluster bean; Prakash (1967) of sugarcane; Kulshreshtha (1969) of maize; Kumar and Chakarvarti (1970) of maize, Srivastava and Mishra (1971) of barley and wheat; Mathur and Chauhan (1972) of gram; Luke and Vani (1972) of tobacco; Natrajan (1972) of *Pennisetum* sp.; Kamal and Singh (1974) of sugar cane; Gangawane and Deshpande (1975 and 1977) of groundnut; Murthy and Raghu (1976) of barley and cowpea; Kulshreshtha *et al.* (1977) of maize;

Manoharacharya *et al*. (1977) of sesame and sunflower; Rao and Sharma (1978) of cauliflower; Dutta (1979) of tomato; Rai and Upadhyay (1980) of pigeon pea; Dwivedi and Pathak (1981) of tomato; Ansari and Prakash (1981) sorghum; Khan and Prakash (1982) of gram; Ansari (1982) of sorghum and barley.

Legumes are next in importance to cereals as a source of human food. They contain more protein than any other vegetable product, and so are nearer to animal flesh in food value. Legumes are also quite valuable as field and forage crops. Pigeon pea (*Cajanus cajan* (L.) Millsp.) is an important leguminous crop (pulse crop) in the Indian subcontinent and widely grown in South-East Asia, Africa and Central America. Approximately 90 percent (2-6 million hectares) of the world's pigeon pea crop area is in India. More than 50 pathogens have been reported on pigeon pea from 23 countries, and most of these reports are from India (Nene, 1980). In India wilt of pigeon pea caused by *Fusarium udum* Butler is one of the major disease problems. Pigeon pea has been grown in almost every state of India. In a recent survey the incidence of wilt disease of pigeon pea in different state was as given under:-

Andhra Pradesh - 5.3 percent, Bihar - 18.3 percent, Gujrat - 5.4 percent, Karnataka - 1.1 percent, Madhya Pradesh - 5.4 percent, Maharashtra - 22.6 percent, Orissa - 0.3 percent, Rajasthan - 0.1 percent, Tamil Nadu - 1.4 percent, Uttar Pradesh - 8.2 percent and West Bengal - 6.1 percent. The incidence of wilt in farmers' field varied between 0 to 97% (Kannaiyan *et al.*, 1981). According to calculations made by J.G. Ryan, Programme leader (Economics), International Crop Research Institute for Semi Arid Tropics (ICRISAT), Patancheru, India, wilt of pigeon pea caused losses in India worth about $ 113 million annually (Kannaiyan *et al.*, 1981).

From the foregoing survey of literature it may, however, be admitted that quite little work has been carried out on the rhizosphere and rhizoplane mycoflora of pigeon pea in relation to wilt disease caused by *Fusarium udum* Butler. Hence, in the present investigations an attempt has been made to study the following aspects:-

1. Rhizosphere and rhizoplane mycoflora of uninoculated and inoculated pigeon pea plants with *Fusarium udum* Butler at varying age.

2. Rhizosphere and rhizoplane mycoflora of different cultivars of pigeon pea viz., T-21, No. 148, Pant A-10, ICPL-227, ICPL-42, DL-78-2, BDN-1 and BDN-2 uninoculated and inoculated with *F. udum*.

3. Rhizosphere and rhizoplane mycoflora of uninoculated and inoculated plants with *F. udum* of pigeon pea cultivars T-21 and BDN-1 in relation to foliar spray such as - indole acetic

acid, indole butyric acid, thio-indole butyric acid, gibberellic acid, maleic hydrazide, urea, muriate of potash, bavistin, vitavax, brassicol, benlate, fytolan, captan, wettable sulphur, 2,4-dichlorophenoxyacetic acid and streptomycin.

4. Rhizosphere and rhizoplane mycoflora of uninoculated and inoculated plants with F. udum of pigeon pea cultivars T-21 and BDN-1 in relation to soil amendments viz.,urea, superphosphate, muriate of potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur.

CHAPTER - II

MATERIALS AND METHODS

All the experiments were conducted in field conditions at the Botanical Garden of Aligarh Muslim University, Aligarh.

Preparation of field:

Thoroughly ploughed field was divided into 10 sq.m. beds, each with separate water channels, leaving 0.5 m. buffer zone between them.

There were three beds for each treatment.

Isolation of fungi from rhizosphere, rhizoplane and non-rhizosphere:

For isolating fungi from rhizosphere five plants were removed carefully from the field and brought to the laboratory in sterilized containers. Under aseptic conditions blocks of soil containing plant roots were cut out and gently crushed with as little tearing of the roots as possible. The roots were taken out from the containers and gently shaken to remove superfluous soil. Then they were placed along with adhering soil particles in weighed 250 ml Erlenmeyer flask, containing 100 ml of sterilized distilled water. The roots were gently shaken several times in the sterilized distilled water and the resultant suspension was used as stock solution. Ten ml of this stock solution was transferred in another flask containing 90 ml of sterilized distilled water, and the flask was shaken. Further, 1 ml solution from this dilution was transferred in another flask containing 99 ml of sterilized distilled water, and the flask was shaken. Thus 1:1000 dilution from stock solution was achieved in the last solution. With the help of a sterilized pipette 1 ml of 1:1000 dilution was placed in petridishes and 10 ml of melted cooled peptone dextrose agar* was poured. Petriplates were rotated gently inorder to obtain equal distribution of solution and medium (Timonin, 1940).

For each treatment 20 petriplates were used. Petriplates were incubated at 28°C and the fungi which developed after one week were examined and identified. The frequency was calculated by the formula:

$$\frac{\text{Number of plates containing a particular fungus}}{\text{Total plates poured}} \times 100$$

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*Peptone dextrose agar medium:

Agar	20.0 g
KH_2PO_4	1.0 g
Peptone	5.0 g
Dextrose	10.0 g
Distilled H_2O	1000.0 ml
Rose bengal	1:30,000
Streptomycin or	30 μg/ml
Aureomycin	20 μg/ml (Martin, 1950; Johnson, 1957).

For determining the weight of rhizosphere soil, roots were removed from the original dilution flask and washed. The washed water was collected in the original flask containing stock solution. The water was evaporated on a water bath and the soil residue was dried to constant weight in an oven at 105°C. The flask containing dry soil was weighed and the dilution factor calculated, allowance being made for the amount of soil removed in preparing the dilutions. Plate counts were made and the number of microorganisms per gram of oven-dry "rhizosphere soil" was computed.

For isolating rhizoplane mycoflora the serial root washing technique of Harley and Waid (1955) was employed. Roots were washed thoroughly several times in sterilized distilled water and cut into small pieces of 3 mm length. These root pieces were washed again several times in sterilized distilled water and then transferred into sterilized petriplates, five root pieces in each petriplates, containing 10 ml sterilized melted cooled peptone dextrose agar medium. Petriplates were incubated at 28°C for one week and the fungi that developed were examined and identified. The frequency of the fungi was calculated by the method discussed earlier.

For studying the non-rhizosphere soil mycoflora, soil was brought from uncultivated portions of the field. Randomise sampling was done with the help of an auger by removing soil upto a depth of 10 cm. Under aseptic conditions, these samples were mixed thoroughly inorder to get a composite sample. Twenty five g of soil (on dry weight basis) was taken from this composite sample and placed into 1000 ml Erlenmeyer flask and 250 ml of sterilized distilled water was added. Flask was shaken vigorously and the resultant suspension was used as stock solution. From this stock solution a dilution of 1:1000 was achieved by transferring 10 ml of stock solution to another flask containing 90 ml of sterilized distilled water, further 1 ml of solution from this dilution was transferred to another flask containing 99 ml of sterilized distilled water. After each transfer flasks were gently shaken. One ml of 1:1000 dilution was transferred into petriplates and 10 ml of melted cooled peptone dextrose agar was added. Petriplates were rotated gently inorder to obtain an equal distribution of solution and medium. For each treatment 20 petriplates were taken. Petriplates were incubated at 28°C for one week and fungi which developed were identified and counted. The frequency of the fungi was calculated by the method discussed earlier. Dilution factor was calculated and the number of microorganism of oven-dry "non-rhizosphere" soil was computed.

Rhizosphere fungal population was compared with the population of non-rhizosphere by using a numerical value, the R/S ratio. R:S ratio was calculated on the basis of:

$$\frac{\text{Number of organisms per gram of rhizosphere soil}}{\text{Number of organisms per gram of non-rhizosphere soil}}$$

Maintenance of cultures and raising inoculum of wilt pathogen of pigeon pea *Fusarium udum* Butler.

Pure culture of *Fusarium udum* was maintained in several sterilized culture tubes on potato dextrose agar medium.[*1] From these cultures, the pathogen was raised by transferring aseptically on 250 g of corn meal sand media,[*2] kept in 1000 ml Erlenmeyer flasks which were then incubated at 28°C for 15 days.

Inoculation of wilt pathogen (*Fusarium udum* Butler) in the field.

Inoculation in the field was done either by making holes in the soil and putting 5-10 g of inoculum with the seed of pigeon pea and then covering the hole with the soil during

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*1 Potato dextrose agar medium:

Agar	17 g
Potatoes (peeled and sliced)	200 g
Dextrose	20 g
Water	1000 ml

(Riker and Riker, 1936).

*2 Cornmeal sand medium:

Corn meal	1000 g
Washed white sand	1000 g
Water	1500 ml.

sowing or by putting 5-10 gm of inoculum around the roots of 10 days old seedling by making holes around them and then covering with soil.

Biochemical analysis of root extract of uninoculated and inoculated plants (with *Fusarium udum* Butler) of pigeon pea:

Preparation of root powder:

Uninoculated and inoculated plants (25 plants each) were collected from the field, immediately roots were removed from top and roots were brought to the laboratory in polythene bags. The roots were washed thoroughly in running water and then in sterilized distilled water. These roots were dried in a thermostat running at 60°C for 48 hours. Powder from dried roots of uninoculated and inoculated plants of pigeon pea was made separately in an electric grinder and then sieved through 60 mesh pore sieve.

Estimation of total free amino acids:

Amino acids were estimated by using the method of Moore and Stein (1954) using modified ninhydrin reagent. Ninhydrin reagent was prepared by dissolving 20 g of ninhydrin and 3 g of hydrindantin[*1] in 750 ml of methyl cellosolve (2-methoxyethanol). The mixture was gently stirred. To this 250 ml of sodium acetate buffer[*2] of pH 5.5 was added. The resulting reddish solution was immediately transferred to a dark glass bottle.

For the preparation of standard curve 10 mg of leucine was dissolved in 100 ml of double distilled water. One ml of this solution was diluted to 10 ml by adding required amount of water. Different amounts of aliquotes 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 ml were taken and the final volume in each case was made to 1 ml by further addition of distilled water. To 1 ml of the above solution 1 ml of

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*1 Hydrindantin: 8 g of ninhydrin was dissolved in 200 ml of distilled water at 90°C. In another solution 8 g of ascorbic acid was dissolved in 40 ml of distilled water at 40°C. The two solutions were immediately mixed and later cooled under tap water. The crystals of hydrindantin thus obtained after filteration, were washed and dried in a vacuum dessicator in dark and stored in dark glass bottle.

*2 Sodium acetate buffer: The 4N sodium acetate buffer of pH 5.5 was prepared by dissolving 272 g of sodium acetate (reagent grade) in 700 ml of distilled water over water bath. After cooling at room temperature 50 ml of glacial acetic acid was added and then final volume was made upto 500 ml. The pH of the buffer was later checked by pH meter.

ninhydrin reagent was added and the solution was passed for 15 minutes over a water bath. The violet coloured solution was diluted to 10 ml by adding more distilled water. Optical densities were measured in Bausch and Lomb spectronic-20-calorimeter at 570 nm against the reagent blank. A graph between the optical densities and different concentrations was plotted which was a straight line.

For the estimation of total free amino acids 100 mg dried sample of powdered material was extracted with 5 ml, 80% boiling ethanol and centrifuged at 3000 rpm for 15 minutes. Extract, thus obtained, was diluted to 10 ml by adding required amount of 80% ethanol. Later 1 ml of this solution, 1 ml ninhydrin reagent and 8 ml distilled water were mixed in the same manner as described above and optical densities were measured. Values were calculated from the standard curve.

Separation and identification of amino acids by paper chromatography:

Chromatographic separation of individual amino acids was done by following the method of Block (1950). Separation of amino acids was carried out on Whatman No.1 filter paper sheets with n-butanol:glacial acetic acid:water (12:3:5) as a descending solvent. Alcoholic extracts of sample along with 22 available amino acids were spotted on sheets which were suspended in the chromatographic chamber in identical conditions for 10 hours. After taking them out from the chamber the sheets were dried in the air. The amino acids were detected by spraying the sheets with 0.2% (v/v) of ninhydrin in water saturated butanol. The sheets were first dried in air and then in oven at 100°C for 2 minutes. The amino acid were identified by comparing R.f. values with that of check. The R.f. values of various spots were calculated with the help of following formula:

R.f. value = a/b; where a = distance travelled by the known sample in cm, and b = distance travelled by the solvent in cm.

Estimation of phenols:

Phenols were estimated following the method of Biehn *et al.* (1968) by using Folin-Ciocatteau reagent (Bray and Thrope, 1954). Folin-Ciocalteau reagent was prepared by dissolving 100 g of sodium tungstate and 25 g of sodium molybdate in 700 ml of distilled water. To the above solution 50 ml of 85% phosphoric acid and 100 ml of concentrated hydrochloric acid were added. This was then reflexed for 10 hours. Later 150 ml of lithium sulphate, 60 ml of double distilled water and few drops of liquid bromine were added. The mixture was then boiled over a free flame for about 15 minutes to remove excess bromine and was cooled at room temperature. The solution was filtered and made to 1000 ml by adding more distilled water. Its normality was adjusted to 1-N before use.

A standard curve of different concentrations of phenols was prepared by dissolving 10 mg of paracresol in 100 ml of 80% butanol. One ml of paracresol solution was diluted again by adding 10 ml of 80% ethanol. From this solution 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 ml were transferred to test tubes and the volume in each case was made up to 1 ml by adding required amount of 80% ethanol. Two drops of concentrated hydrochloric acid were added and then solution was heated over flame, avoiding over-heating. Thereafter 1 ml of 1-N Folin-Ciocalteau reagent and 20 ml of 4% of sodium carbonate were added. After 20 minutes the optical density was measured by using Bausch and Lomb spectronic-20-calorimeter at 660 nm against a reagent blank. A straight line curve obtained by plotting different concentration of paracresol and optical densities, served as standard curve.

For estimating total phenols in the samples, 100 mg dried, powdered sample was heated with 5 ml of 80% ethanol for 15 minutes over water bath, and then centrifuged for 5 minutes at 3000 rpm. The alcoholic extract was taken out and made up to 10 ml by adding required amount of 80% ethanol. To 1 ml of this solution, 1 ml Folin-Ciocalteau reagent, 2 drops of concentrated hydrochloric acid and 20 ml of 4% sodium carbonate were added. Optical density was measured and the concentration of phenols was calculated by using the standard curve.

Estimation of o-dihydroxy phenols:

Estimation of o-dihydroxy phenols was made following the method of Johnson and Schaal (1954) by using Arnows reagent.

The following three stock solutions were prepared:

1. 0.5-N-hydrochloric acid
2. Nitrate molybdate reagent: 10 g of sodium molybdate was dissolved in 100 ml of distilled water. In this solution 10 g of sodium nitrate was dissolved.
3. 1-N-sodium hydroxide.

For obtaining standard curve 10 mg of catechol was dissolved in 100 ml of 80% ethanol. One ml of this solution was again diluted by adding 10 ml of 80% ethanol. Different amounts of aliquotes 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 ml were taken and the final volume in each case was made to 1 ml by adding required amount of 80% ethanol. To each of the 1 ml of the above solution 1 ml of 0.5 N HCl and 1 ml of molybdate reagent was added. As a result of which yellow colour developed. To this yellow coloured solution 1 ml of 1 N NaOH was added and the volume was made up to 5 ml by adding required amount of distilled water which resulted in the change of colour to red. This red coloured solution was read in Bausch and Lomb spectronic-20-calorimeter at 530 nm against reagent blank and the optical density was noted. A straight line graph plotted between different concentrations of catechol and the optical density served as standard curve.

For estimation o-dihydroxy phenols 100 mg dried sample of powdered material was extracted with 5 ml 80% boiling ethanol and centrifuged at 3000 rpm for 15 minutes and the filtrate was collected. The final volume of the alcoholic filtrate was adjusted to 10 ml by adding required amount of 80% ethanol. One ml of each of the sample obtained above was taken to 5 ml caliberated test tubes to which a reagent (containing 1 ml of 0.5 NHCL + 1 ml molybdate nitrite reagent + 1 ml of 1 N NaOH + water to the final volume 5 ml) was added and the optical density was noted in the manner described above and the concentration of total o-dihydroxyphenols was calculated from standard curve.

Estimation of total carbohydrates:

Total carbohydrates were extracted and estimated by the method of Yih and Clark (1965) and Dubois et al. (1956) respectively.

For making the standard curve 10 mg of glucose (analar) was dissolved in 100 ml of distilled water and 1 ml of this solution was again diluted to 10 ml by adding required amount of distilled water. Different aliquotes of this solution viz. 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 ml were transferred to test tubes and final volume of each was made up to 1 ml by adding distilled water. To these solutions 1 ml of 5% ethanol and 5 ml of concentrated H_2SO_4 (analar) were added. After 10 minutes the optical density was measured in Bausch and Lomb spectronic-20-calorimeter at 490 nm against a reagent blank. A graph was plotted between optical density and different concentrations of glucose, which was a straight line.

For estimation of total carbohydrates, 100 mg dried sample of powdered material was boiled for 30 minutes in 5 ml concentration 1N H_2SO_4 for 30 minutes over water bath and latter was centrifuged at 1000 rpm for 10 minutes. The solution was collected in a flask and residue was washed twice with distilled water. This aqueous filtrate was added in the filtrate kept in flask and volume was made upto 100 ml by adding distilled water. To 1 ml of this final solution, 1 ml of 5% ethanol and 5 ml of concentrated H_2SO_4 was added in the same manner as described above. Optical density was measured. Values of total carbohydrates calculated from the standard curve.

Rhizosphere and rhizoplane mycoflora of un-inoculated and inoculated pigeon pea plants (with *Fusarium udum* Butler) at varying age:

The seeds of cultivar T-21 procured from Indian Agricultural Research Institute, New Delhi, were sown after surface sterilization and after washing several times in sterilized distilled water. One set of beds were inoculated with the wilt pathogen *Fusarium udum*, however, other set remained uninoculated. Rhizosphere, rhizoplane and non-rhizosphere soil mycoflora studies were made at 1 month intervals from seedling to senescence. Quantitative estimation were made for total free amino acids, phenols, o-dihydroxyphenols and sugars from root extract of both uninoculated and inoculated plants at 1 month intervals from seedling to senescence. Qualitative detection for amino-acids from root extract of uninoculated and inoculated plants were made from 120 days old plants. Methods used for studying rhizosphere, rhizoplane and non-rhizosphere soil, for estimating quantitatively free amino acids, phenols, o-dihydroxy phenols and sugars; for qualitative detection of amino acids; and determining frequency, population and R:S ratio has been discussed earlier.

<u>Rhizosphere and rhizoplane mycoflora of different cultivars of pigeon pea plants, uninoculated and inoculated with *Fusarium udum*.</u>

Seeds of different pigeon pea cultivars viz., T-21, No. 148, Pant A-10, ICPL-227, ICPL-42, DL-78-2, BDN-1 and BDN-2, procured from Indian Agricultural Research Institute, New Delhi, were sown. One set of plots of each cultivar was inoculated with *Fusarium udum*, while others remained uninoculated. Rhizosphere and rhizoplane mycoflora of different cultivars uninoculated and inoculated was studied from 120 days old plants. Estimations of total free amino acids, phenols, o-dihydroxy phenols and sugars were also made from the roots of uninoculated and inoculated plants of different cultivars. Methods used for studying rhizosphere and rhizoplane mycoflora; estimation of total free amino acids, phenols, o-dihydroxy phenols and sugars; and determination of frequency and population has already been discussed.

<u>Rhizosphere and rhizoplane mycoflora of uninoculated and inoculated plants (with *Fusarium udum* Butler) of pigeon pea cultivars T-21 and BDN-1 in relation to foliar spray:</u>

For foliar spray 100 ppm of indole acetic acid, indole butyric acid, thio-indole butyric acid, gibberellic acid, maleic hydrazide, 2,4-dichlorophenoxyacetic acid, streptomycin, urea and potash; and 1500 ppm of bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur were prepared in sterilized distilled water. Those chemicals which did not dissolve in distilled water, were first dissolved in little amount of absolute alcohol and then diluted in distilled water. Equal length of 15 days old uninoculated and inoculated plants of cultivars T-21 and BDN-1 were selected for spraying. The chemicals were sprayed by home spray atomizer. At the time of spraying care was taken to see that solution sprayed only on foliage of the plant and not on soil, by covering soil surface with plastic sheets. Plants sprayed with distilled water served as control. Three spraying were done at 15 days intervals from the date of first spraying and after 14 days of each spraying, the rhizosphere, rhizoplane and non-rhizosphere soil was analysed. Methods employed for studying rhizosphere, rhizoplane and non-rhizosphere mycoflora and for determining frequency and population have already been discussed.

<u>Rhizosphere and rhizoplane mycoflora of uninoculated and inoculated plants (with *Fusarium udum* Butler) of pigeon pea cultivars T-21 and BDN-1 in relation to soil amendments:</u>

The ploughed fields were treated separately with different fertilizers viz., urea (@ 11 lb per acre), superphosphate (@ 20 lb per acre) and muriate of potash (@ 70 lb per acre); oil cakes viz., neem oil cake, groundnut cake, castor cake, mustard cake (@ 100 lb per acre each) and mahua cake (@ 50 lb per acre); pesticides viz., bavistin (@ 10 kg per hectare), vitavax (@ 35 kg per hectare), brassicol, benlate, fytolan, captan and wettable sulphur (@ 6 kg per hectare each). The granular form of these amendments were mixed with the soil prior to 15 days of sowing. For each treatment six beds were cho-sen for each cultivar. One bed was left untreated which served as control. All the beds were watered after treatments. One set of three beds were inoculated with Fusarium udum, while other set remained uninoculated.

Rhizosphere, rhizoplane and non-rhizosphere studies were made from uninoculated and inoculated plants of cultivars T-21 and BDN-1 from 120 days old plants. Methods used for studying rhizosphere, rhizoplane and non-rhizosphere mycoflora and for determining frequency, population and R:S ratio were the same as discussed earlier.

CHAPTER - III

EXPERIMENTAL RESULTS

1. RHIZOSPHERE AND RHIZOPLANE MYCOFLORA OF UNINOCULATED AND INOCULATED PIGEON PEA PLANTS WITH FUSARIUM UDUM BUTLER AT VARYING AGE.

It is evident from the table 4 that out of 39 fungal species isolated during the course of study, 24 were recorded from non-rhizosphere, 28 from rhizosphere of uninoculated plants and 25 from the rhizosphere of inoculated plants of pigeon pea. Most of the fungi were common in the rhizosphere of uninoculated plants and non-rhizosphere soil. <u>Circinella tenella</u> (Ling-Young) Zycha, <u>Aspergillus funiculosus</u> G. Smith, <u>A. sulphureus</u> (Fresenius) Thom & Church, <u>A. candidus</u> Link, <u>A. terricola</u> Marchal, <u>Neocosmospora vasinfecta</u> E.F. Smith, <u>Cephalosporium roseo-griseum</u> Saksena, <u>Gelasinospora cerealis</u> Dowding and black sterile mycelium were confined to the rhizosphere of uninoculated plants. On the other hand, <u>Mortierella alpina</u> Peyroud, <u>Pyrenochaeta</u> <u>cajani</u> Singh & Pavgi, <u>Monilia brunnea</u> Gilman & Abbott, <u>Rhizoctonia solani</u> Kuhn and white sterile mycelium were restricted to the non-rhizosphere soils. Qualitative differences were recorded in the rhizosphere of uninoculated and inoculated plants. Certain forms viz. <u>Circinella tenella</u>, <u>Aspergillus luchuensis</u> Inui, <u>A. sulphureus</u>, <u>Neocosmospora vasinfecta</u>, <u>Cephalosporium curtipes</u> Saccardo, <u>C. roseo-griseum</u>, <u>C. asperum</u> Marchal, <u>Gelasinospora cerealis</u>, <u>Trichoderma</u>

viride Pers. ex Fr., Fusidium viride Grove and black sterile mycelium were isolated only from the rhizosphere of uninoculated plants while Cunninghamella echinulata Thaxter, Mortierella alpina, Aspergillus candidus, Pyrenochaeta cajani, Monosporium olivaceum Cooke & Massee, Fusarium udum Butler, Rhizoctonia solani and yellow sterile mycelium only from inoculated counterparts.

The number of fungal species in the rhizosphere of both uninoculated and inoculated plants exhibited fluctuations. From 30, 60, 90, 120, 150, 180, 210 and 240 days old plants 18, 21, 20, 20, 17, 19, 21, and 17 fungi were recorded in the rhizosphere of uninoculated plants, and 19, 19, 22, 19, 20, 19, 20 and 21 in the inoculated counterparts respectively. Aspergillus fumigatus Fresenius, A. flavus Link and Curvularia pallescens Boedijn were recorded throughout the growth period of the plant in both the rhizosphere. Aspergillus terricola was detected throughout the growth period except 90, 150 and 210 days old plants in both uninoculated and inoculated plants rhizosphere. Phoma hibernica Grimes, O'Connor, and Cummins was recorded from 90 to 240 days and Cladosporium herbarum (Persoon) Link from 120 to 240 days old plants in the rhizosphere of both uninoculated and inoculated plants. Rhizopus oryzae Went & Gerlings was detected from 30 to 90 days old plants in both the rhizosphere and from 120 to 210 days in only uninoculated plants; *Aspergillus funiculosus* in both the rhizosphere from 30 days old plants, from 60 and 90 days in uninoculated ones and from 120, 180, 210 and 240 days old plants in inoculated counter-parts; *Chaetomium flavum* Omvik was recorded from 60 to 240 days old plants in the rhizosphere of uninoculated plants and 90 to 240 in the inoculated counterparts. From the rhizosphere of uninoculated plants *Aspergillus sulphureus* was detected at all intervals of growth period; *A. luchuensis* at all intervals except 120 and 150 days; *Gelasinospora cerealis* except 30, 120 and 150 days. *Circinella tenella* was isolated from 30 to 90 days old plants and black sterile mycelium from 30 to 150 days old plants. However, in the rhizosphere of inoculated counterparts *Mucor racemosus* Fresenius, *Cunninghamella echinulata*, *Monosporium olivaceum* and *Fusarium udum* were noticed throughout the growth period of plants. *Mortierella alpina* was isolated from all intervals except 180 days old plants. *Rhizoctonia solani* was noticed from 60 to 240 days; *Sclerotium rolfsii* Saccardo from 60 to 240 days except 120 days old plants; and yellow sterile mycelium from 30 to 180 days except 120 days old plants. The remaining fungi did not follow any definite pattern of occurrence.

The frequency of most of the fungi increased in the rhizosphere of uninoculated plants with the increase in age to a certain period, then slightly decreased and finally in most of the cases increased again. It is clear from table 4 that frequency of Aspergillus fumigatus in the rhizosphere of uninoculated plants from 30, 60, 90, 120, 150, 180, 210 and 240 days old plants was 60, 60, 80, 80, 40, 60, 60 and 100; A. flavus 45, 60, 60, 70, 45, 40, 50 and 60; A. sulphureus 20, 25, 30, 25, 20, 10, 10 and 20; Cephalosporium curtipes 30, 40, 60, 50, 30, 30, 30 and 20; Curvularia pallescens 10, 10, 10, 10, 20, 20, 10 and 10 respectively for the corresponding ages of the plant. The frequency of Rhizopus oryzae in the rhizosphere of uninoculated plants was 25, 30, 45, 30, 10, 10 and 10 when the plants were 30, 60, 90, 120, 150, 180 and 210 days old; Circinella tenella was 10, 30, and 10 when the plants were 30, 60 and 90 days old; A. nidulans (Eidam) Winter was 30, 35, 40, 30, 10, 10 and 10 when the plants were 30, 60, 90, 120, 180, 210 and 240 days old; Chaetomium flavum 10, 20, 20, 15, 15, 15 and 10 when the plants were 60, 90, 120, 150, 180, 210 and 240 days old; Alternaria alternata (Fr.) Keissler 20, 30, 30, 10 and 20 when the plants were 120, 150, 180, 210 and 240 days old. In certain fungi an increase in frequency was observed with the increase in age of the plant viz., Neocosmospora vasinfecta frequency was 15, 20, 20, 20 and 20 from 120, 150, 180, 210 and 240 days old plants; Trichoderma viride 30 and 35 from 30 and 60 days old plants; and *Drechslera australiensis* (Bugnicourt) Subram. & Jain ex M.B. Ellis 10, 15, 20, 20, 30 and 30 from 30, 120, 150, 180, 210 and 240 days old plants. Rest of the fungi either showed no change in the frequency or did not follow any definite pattern. In the non-rhizosphere, on the other hand, no definite pattern with regard to frequency has been observed. In the rhizosphere of inoculated plants most of the fungi showed either increase or decrease in frequency with the increase in age of the plant; however, rest of the forms did not show any definite pattern. The frequency of *Rhizopus oryzae* in the rhizosphere of inoculated plants was 20, 10, 10 and 10 when the plants were 30, 60, 90 and 210 days old. In 30, 60, 90, 120, 150, 180, 210 and 240 days old plants the frequency of *Aspergillus fumigatus* was 60, 40, 40, 30, 20, 40, 40 and 50; *A. flavus* 40, 30, 20, 10, 10, 20, 25, 30 for the corresponding ages of plants; *A. terreus* Thom 30, 30, 10, 10, 10 and 10 from 30, 60, 150, 160, 190, 210 and 240 days old plants. However, the frequency of *Pyrenochaeta cajani* in the rhizosphere of inoculated plants from 90, 120, 150, 180, 210 and 240 days old plants was 20, 30, 30, 35, 30 and 40; *Phoma hibernica* 30, 30, 40, 35, 20 and 20; *Chaetomium flavum* 20, 25, 30, 35, 40 and 40 respectively. Frequency of *Fusarium udum* from 30, 60, 90, 120, 150, 180, 210 and 240 days old plants was 65, 70, 80, 100, 100, 100, 80 and 70 respectively; *Fusarium oxysporum* Schlecht from 30, 60, 90, 150 and 210 days old plants, 10, 20, 40, 45, and 50; Drechslera australiensis from 30, 90, 120, 150, 180, 210 and 240 days old plants 20, 25, 30, 35, 40, 45 and 50; Curvularia pallescens from 30, 60, 90, 120, 150, 180, 210 and 240 days old plants 10, 15, 15, 20, 30, 40, 45 and 40; Alternaria alternata from 30, 60, 90, 150, 180, 210 and 240 days old plants 10, 15, 20, 40, 50, 50 and 50; Cladosporium herbarum from 120, 150, 180, 210 and 240 days old plants 10, 15, 20, 25, and 20; Rhizoctonia solani from 60, 90, 120, 150, 180, 210 and 240 days old plants 10, 15, 20, 25, 30, 40 and 40; and Sclerotium rolfsii from 60, 90, 150, 180, 210 and 240 days old plants 10, 10, 40, 40, 40 and 45. It is evident from the above results that the frequency of Fusarium udum, in the rhizosphere of inoculated plants, increased with the increase in age of the plant and attained maximum value from 120 to 180 days old plants and slightly decreased at the onset of senescens. The frequency of most of the saprophytic forms decreased with the increase in age of the plant, in the rhizosphere of inoculated plants, however, reverse was true with the parasitic fungi. The saprophytic fungi exhibited higher frequency in the rhizosphere of uninoculated plants in comparison to their inoculated counterparts. However, the frequency of parasitic forms was higher in the rhizosphere of inoculated plants in comparison to their uninoculated counterparts.

From the rhizoplane of uninoculated and inoculated plants of pigeon pea 22 and 24 fungal species were isolated (Table 5). The number of fungi recorded at 30, 60, 90, 120, 150, 180, 210 and 240 days old plants was 13, 14, 17, 17, 21, 20, 20 and 20 in uninoculated plants and 10, 9, 15, 17, 18, 16, 16 and 15 in inoculated counterparts respectively for the corresponding ages. Aspergillus fumigatus, A. flavus and A. niger van Tieghem were recorded in the rhizoplane of both uninoculated and inoculated plants throughout the growth period of the plant. Phoma hibernica, Drechslera australiensis, Curvularia pallescens and Cladosporium herbarum were isolated from 120 to 240 days old plants; D. hawaiiensis (Bugnicourt) Subram. & Jain ex M.B. Ellis from 90 to 240 days old plants in the rhizosphere of both uninoculated and inoculated plants. Rhizopus oryzae was noticed in the rhizoplane of both uninoculated and inoculated plants from 30 to 120 days, in the rhizoplane of only uninoculated plants from 150 and 180 days and inoculated counterpart from 210 days old plants; A. funiculosus from 30 days old plants in both the rhizoplane and onwards at all intervals from uninoculated plants only; A. luchuensis and A. nidulans from 60 and 90 days old plants in both the rhizoplane and further at all age intervals from uninoculated plants only; white sterile mycelium from 90 days in both the rhizoplane and at further intervals from uninoculated plants only. However, Circinella tenella, Aspergillus sulphureus, Cephalosporium curtipes, C. roseo-griseum, Trichoderma viride and T. album Preuss were recorded at all age intervals in the rhizoplane of uninoculated plants only. Aspergillus terreus was recorded from 60 to 240 days old plants, black sterile mycelium from 30, 150 and 210 days old plants in the rhizoplane of uninoculated plants only. Mucor globosus Fischer and Fusarium udum were recorded in the rhizoplane of only inoculated plants at all intervals of plant growth; Cunninghamella echinulata from 30 to 150 days; Pyrenochaeta cajani from 90 to 240 days; Rhizoctonia solani from 90 to 240 days; Sclerotium rolfsii from 120 to 240 days; and yellow sterile mycelium from 30 to 150 days old plants.

In the rhizoplane of uninoculated plants the frequency of Circinella tenella from 30, 60, 90, 120, 150, 180, 210 and 240 days old plants was 20, 30, 45, 15, 10, 10, 10 and 10; Aspergillus fumigatus, 70, 80, 100, 90, 90, 85, 80 and 100; A. funiculosus 20, 30, 30, 10, 5, 10, 15 and 15; A. flavus 55, 60, 70, 65, 65, 50, 70 and 80; A. niger 20, 25, 35, 35, 35, 30, 25 and 35; A. luchuensis 10, 15, 20, 20, 15, 15, 15 and 20; A. sulphureus 10, 20, 40, 40, 30, 30, 40 and 40; Cephalosporium curtipes 25, 30, 45, 50, 45, 30, 20 and 20; C. roseo-griseum 10, 15, 20, 25, 20, 15, 15 and 15; Trichoderma viride 20, 25, 30, 35, 35, 40, 40 and 40; and

T. album 10, 10, 10, 15, 20, 20, 10 and 15 respectively for the corresponding ages of the plant. Frequency of *Phoma hibernica* was 10, 15, 15, 25, 20 when the plants were 120, 150, 180, 210 and 240 days old; *Chaetomium flavum* 10, 15, 15 and 10 when the plants were 150, 180, 210 and 240 days old; *Drechslera australiensis* 15, 20, 15, 15, 10, 15 and 20 when the plants were 60, 90, 120, 150, 180 and 210 and 240 days old; *Curvularia pallescens* 10, 20, 35, 40 and 40 when the plants were 120, 150, 180, 210 and 240 days old; *Cladosporium herbarum* 15, 20, 20, 25 and 25 when the plants were 120, 150, 180, 210 and 240 days old. However, in the rhizoplane of inoculated plants the frequency of *Mucor globosus* in 30, 60 90, 120, 150, 180, 210 and 240 days old plants was 10, 30, 25, 20, 20, 10, 10 and 10; *A. fumigatus* 60, 55, 50, 40, 35, 30, 40 and 45; *A. flavus* 45, 45, 40, 35, 30, 25, 20 and 40; *A. niger* 20, 20, 20, 15, 10, 10, 10 and 15; *Fusarium udum* 40, 55, 60, 100, 100, 100, 95 and 90 respectively for the corresponding ages of the plant. Frequency of *Pyrenochaeta cajani* in the rhizoplane of inoculated plants was 15, 25, 25, 30, 35 and 40 when the plants were 90, 120, 150, 180, 210 and 240 days old. *Phoma hibernica* 20, 30, 35, 40 and 40 when the plants were 120, 150, 180, 210 and 240 days old; *Chaetomium flavum* 15, 20, 25, 30, 35 and 30 when the plants were 90, 120, 150, 180, 210 and 240 days old; *Drechslera australiensis* 20, 20, 25, 25, 35, 40 and 45 when the plants were 60, 90, 120, 150, 180, 210 and

240 days old; *D. hawaiiensis* 5, 5, 30, 35, 40 and 30 when the plants were 90, 120, 150, 180, 210 and 240 days old; *Curvularia pallescens* 15, 25, 35, 40 and 40 when the plants were 120, 150, 180, 210 and 240 days old; *C. echinulata* (Tracy & Earle) Boedijn 15, 20, 25, 30 and 35 when the plants were 120, 150, 180, 210 and 240 days old; *Cladosporium herbarum* 20, 25, 30, 40 and 45 when the plants were 120, 150, 180, 210 and 240 days old; *Rhizoctonia solani* 10, 15, 15, 15, and 20 when the plants were 120, 150, 180, 210 and 240 days old. It is clear from the above results that in the rhizoplane of uninoculated plants frequency of most of the fungi increased with the increase in age. However, in the rhizoplane of inoculated plants the frequency of majority of parasitic fungi increased with the increase in the age of the plant; while most of the saprophytic forms decreased with the increase in the age. The frequency of *Fusarium udum* increased till the plants were 120 days old and attained maximum value which remained constant upto 180 days and slightly decreased at senescens.

A perusal of table 1 and fig. 1 reveals that the population of fungi in the rhizosphere of uninoculated plants increased with the increase in age of the plant upto 90 days and then declined upto 180 days and increased again. An almost similar pattern was observed in the rhizosphere of inoculated plants. The population of fungi when the plants were 30, 60, 90, 120, 150, 180, 210 and 240 days old was 66000, 135000, 180000, 150000, 105000, 95000, 130000 and 190000 in the rhizosphere of uninoculated plants; and 79200, 210000, 324000, 300000, 300000, 250000, 210000 and 285000 in the inoculated counterparts respectively. However, in the non-rhizosphere it was 11000, 11500, 13000, 17000, 15000, 13500, 12000 and 10000 respectively for the corresponding periods. Higher fungal population was recorded in the rhizosphere of inoculated plants in comparison to their uninoculated counterparts.

In the uninoculated plants R:S ratio increased with the increase in age of plants upto 90 days and then declined upto 180 days and increased again. Maximum rhizosphere effect was observed when the plants were 240 days old. However, in the inoculated plants R:S ratio increased upto 90 days and decreased till the plant were 120 days old, further showed an increase upto 150 days then declined and again increased in the last. Maximum rhizosphere effect was noticed when the plants were 240 days old. R:S ratio was 6.00, 11.73, 13.84, 8.82, 7.00, 7.03, 10.80 and 19.00 when the plants were 30, 60, 90, 120, 150, 180, 210 and 240 days old in uninoculated plants and 7.20, 18.25, 24.92, 17.64, 20.02, 18.51, 17.50 and 28.50 respectively in the inoculated counterparts.

It is evident from table 3 that no qualitative differences were observed in the free amino acids present in the root extract of both uninoculated and inoculated plants. In total 18 aminoacids viz., arginine, aspartic acid, alanine, cysteine, glycine, histidine, isoleucine, lucein, lysine, threonine, serine, glutamic acid, proline, valine, tyrosine, phenylalanine, α-amino butyric acid and tryptophane were detected from the roots of both uninoculated and inoculated plants. It is clear from table 2 that total free amino acids concentration (mg/100 mg of dry sample) at varying age of the plant i.e., 30, 60, 90, 120, 150, 180, 210 and 240 days old plants was 0.16, 0.74, 0.84, 0.81, 0.64, 0.45, 0.73 and 0.86 in the root extract of uninoculated plants respectively; and 0.30, 0.90, 1.02, 1.01, 0.85, 0.67, 0.92 and 1.02 in the inoculated counterparts. Similarly, the concentrations of total phenols was 0.36, 1.61, 1.83, 1.72, 1.33, 0.95, 1.54 and 1.88 in uninoculated plants and 0.60, 1.92, 2.19, 2.12, 1.75, 1.39, 1.92 and 2.12 in inoculated plants; o-dihydroxy phenols was 0.041, 0.163, 0.215, 0.187, 0.124, 0.093, 0.145 and 0.227 in uninoculated and 0.072, 0.214, 0.275, 0.238, 0.156, 0.117, 0.175 and 0.261 in inoculated plants; concentrations of total sugars was 2.45, 3.25, 3.90, 3.55, 3.05, 2.75, 2.25 and 2.45 in uninoculated and 3.05, 4.04, 4.84, 4.40, 3.81, 3.43, 2.80 and 3.04 in inoculated plants. It is clear from the above results that the concentrations of total free amino acids, phenols, o-dihydroxyphenols and sugars in the roots of uninoculated plants increased till the plants were 90 days old and declined up to 120 days and further increased in the case of free amino acids, phenols and o-dihydroxy phenols; however, the concentrations of sugars did not increase after 90 days. A similar pattern in the concentrations of these chemicals was also observed in inoculated plants. Higher concentrations of free amino acids, phenols, o-dihydroxyphenols and sugars were detected in the roots of inoculated plants in comparison to their uninoculated counterparts.

It is concluded from the above results that age profoundly influenced the rhizosphere population in both uninoculated and inoculated plants of pigeon pea qualitatively and quantitatively. Effect of age was significant at 5% and 1% level. Qualitative and quantitative differences were also evident in the rhizosphere and rhizoplane of uninoculated and inoculated plants of pigeon pea. Population of fungi in the rhizosphere of both the plants showed fluctuation with age of the plant. Frequency of most of the fungi in the rhizosphere of uninoculated plants increased with age upto a certain period, then slightly decreased and finally in most of the cases increased again; however, in the rhizoplane frequency of most of the fungi increased with age. On the other hand, in the rhizosphere and rhizoplane of inoculated plants, the frequency of most of the saprophytic fungi decreased with age and most of the parasitic forms increased. The frequency of Fusarium udum in the rhizosphere and rhizoplane of inoculated plants increased with age of the plant and reached maximum at 120 days to 180 days old plants and slightly declined at senescens. The biochemical composition of roots of uninoculated and inoculated plants also showed variation with age. The concentrations of total free amino acids, phenols, o-dihydroxyphenols and sugars were higher in the roots of inoculated plants in comparison to their uninoculated counterparts. Though no qualitative difference in amino acids was noticed in the roots at 120 days in both uninoculated and inoculated plants.

FIG. 1. Population of fungi in the non-rhizosphere, rhizosphere of uninoculated and inoculated plants of pigeon pea (with *Fusarium udum* Butler) at varying age of the plant.

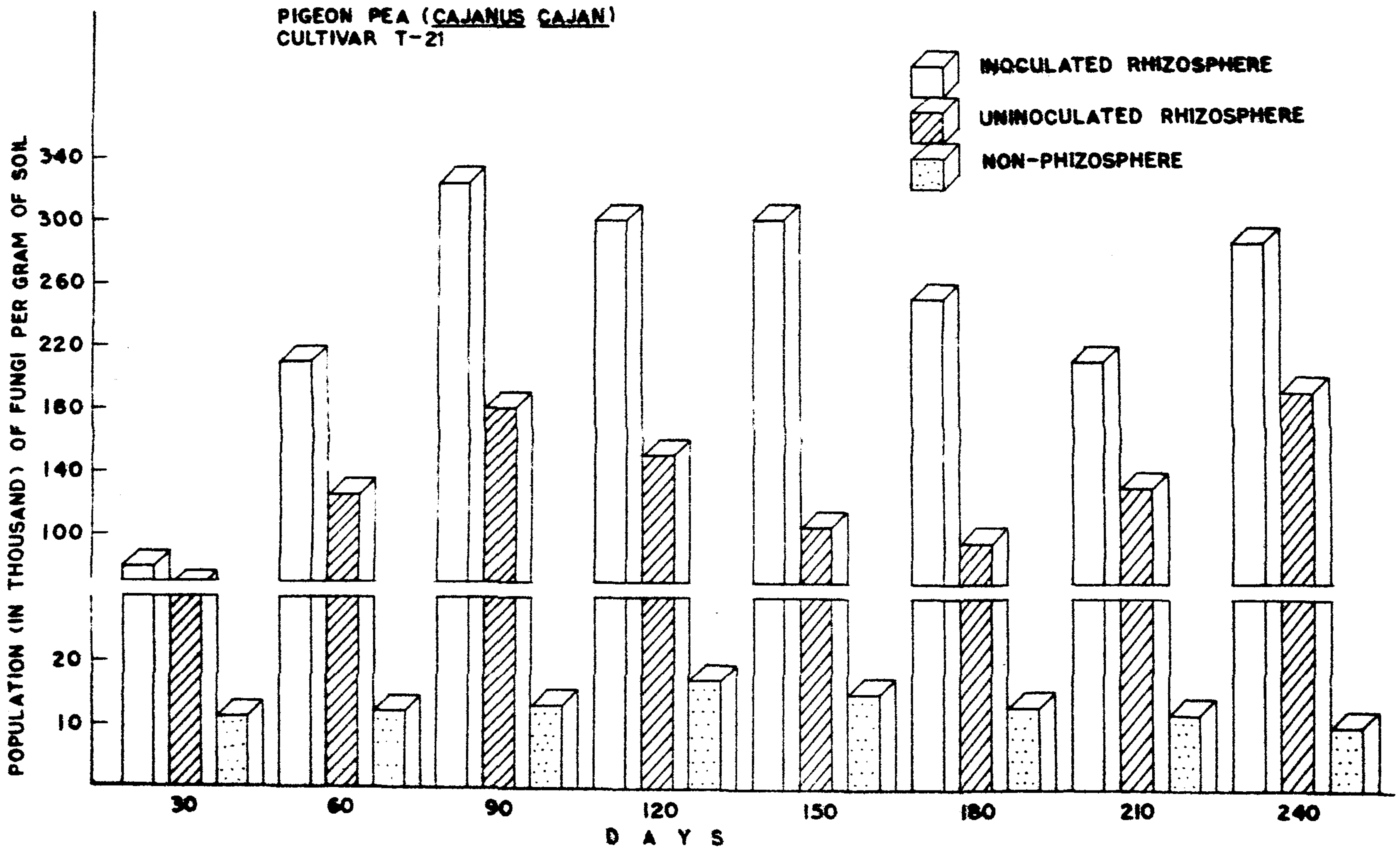

PIGEON PEA (CAJANUS CAJAN)
CULTIVAR T-21
INOCULATED RHIZOSPHERE
UNINOCULATED RHIZOSPHERE
NON-PHIZOSPHERE
POPULATION (IN THOUSAND) OF FUNGI PER GRAM OF SOIL
340
300
260
220
180
140
100
20
10
30
60
90
120
150
180
210
240
D A Y S
FIG. 1

TABLE 1. Population of fungi (per gram of soil) in non-rhizosphere, rhizosphere of uninoculated and inoculated plants, with *Fusarium udum* Butler, pigeon pea (cultivar T-21) at varying age.

Age of plant (days)	Non-rhizosphere (S)	Rhizosphere (R)			
		Uninoculated plants	R:S ratio	Inoculated plants	R:S ratio
30	11*	66	6.00	79.2	7.20
60	11.5	135	11.73	210	18.25
90	13	180	13.84	324	24.92
120	17	150	8.82	300	17.64
150	15	105	7.00	300	20.02
180	13.5	95	7.03	250	18.51
210	12	130	10.80	210	17.50
240	10	190	19.00	285	28.50
L.S.D. at 5%	0.48657	1.13152		1.08519	
L.S.D. at 1%	0.67530	1.57052		1.50612	

*in thousand.

TABLE 2. Total free amino acids, phenols, o-dihydroxy phenols and sugars concentrations (in mg/100 mg of dry sample) in the roots of uninoculated and inoculated plants of pigeon pea (cultivar T-21) with *F. udum* at varying age.

Age of plant (days)	Free amino acids		Phenols		O-dihydroxy phenols		Sugars	
	UP	IP	UP	IP	UP	IP	UP	IP
30	0.16	0.30	0.36	0.60	0.041	0.072	2.45	3.05
60	0.74	0.90	1.61	1.92	0.163	0.214	3.25	4.04
90	0.84	1.02	1.83	2.19	0.215	0.275	3.90	4.84
120	0.81	1.01	1.72	2.12	0.187	0.238	3.55	4.40
150	0.64	0.85	1.33	1.75	0.124	0.156	3.05	3.81
180	0.45	0.67	0.95	1.39	0.093	0.117	2.75	3.43
210	0.73	0.92	1.54	1.92	0.145	0.175	2.25	2.80
240	0.85	1.02	1.88	2.12	0.227	0.261	2.45	3.04
L.S.D. at 5%	0.01462	0.01358	0.01604	0.01982	0.00185	0.00223	0.06190	0.07744
L.S.D. at 1%	0.02029	0.01884	0.02227	0.02751	0.00257	0.00310	0.08591	0.10748

UP = Uninoculated plants. IP = Inoculated plants.

TABLE 3. Amino acids present in the roots of uninoculated and inoculated plants of pigeon pea (cultivar T-21) with *F. udum*.

Amino acids	Uninoculated plants	Inoculated plants
Arginine	+	+
Aspartic acid	+	+
Alanine	+	+
Cysteine	+	+
Glycine	+	+
Histidine	+	+
Isoleucine	+	+
Lucein	+	+
Lysine	+	+
Threonine	+	+
Serine	+	+
Glutamic acid	+	+
Proline	+	+
Valine	+	+
Tyrosine	+	+
Phenyl alanine	+	+
α- Amino butyric acid	+	+
Tryptophane	+	+

TABLE 4. Frequency (percentage) of fungi in non-rhizosphere soil and rhizosphere of uninoculated and inoculated pigeon pea plants (cultivar T-21) with *F. udum* at varying age.

Fungi isolated	DAYS																							
	30			60			90			120			150			180			210			240		
	NR	R		NR	R		NR	R		NR	R		NR	R		NR	R		NR	R		NR	R	
		UP	IP		UP	IP		UP	IP		UP	IP		UP	IP		UP	IP		UP	IP		UP	IP
Rhizopus oryzae Went & Gerlings	20*	25	20	-	30	10	30	45	10	-	30	-	20	10	-	-	10	-	-	10	10	10	-	-
Mucor racemosus Fresenius	-	-	10	-	-	20	-	-	30	-	-	10	-	-	10	-	-	10	-	-	20	-	-	20
Cunninghamella echinulata Thaxter	30	-	30	-	-	20	20	-	15	30	-	10	25	-	-	20	-	-	10	-	10	-	-	20
Circinella tenella (Ling-Young) Zycha	-	10	-	-	30	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	20	-	-	30	10	-	50	-	-	10	-	-	15	-	-	-	-	-	10	-	-	10
Aspergillus fumigatus Fresenius	30	60	60	40	60	40	40	80	40	50	80	30	40	60	20	30	60	40	50	60	40	50	100	50
A. funiculosus G. Smith	-	10	20	-	10	-	-	10	-	-	-	10	-	-	-	-	-	10	-	-	-	-	-	10
A. flavus Link	20	45	40	35	60	30	40	60	20	60	70	10	45	40	10	40	40	20	50	50	25	60	80	30
A. niger van Tieghem	20	20	10	30	30	20	35	10	10	40	-	10	30	-	10	20	10	-	-	20	-	30	20	10
A. luchuensis Inui	-	10	-	-	10	-	-	10	-	-	-	-	20	-	-	10	10	-	10	10	-	-	10	-
A. terreus Thom	10	10	30	20	20	30	-	-	-	40	10	-	30	10	10	25	-	10	10	-	10	-	20	10
A. nidulans (Eidam) Winter	20	30	-	25	35	-	30	40	10	-	30	10	-	-	-	-	10	-	10	10	-	10	10	10
A. sulphureus (Fresenius) Thom & Church	-	20	-	-	25	-	-	30	-	-	25	-	-	20	-	-	10	-	-	10	-	-	20	-
A. candidus Link	-	-	20	-	10	20	-	10	10	-	-	10	-	-	-	-	10	-	-	-	-	-	-	-
A. ustus (Bainier) Thom & Church	-	-	30	-	-	20	-	-	15	-	-	-	-	-	10	-	-	10	-	-	10	-	-	-
A. terricola Marchal	-	30	35	-	40	35	-	-	-	-	30	15	-	-	-	-	10	10	-	-	-	-	10	15
Pyrenochaeta cajani Singh & Pavgi	-	-	-	-	-	-	-	-	20	-	-	30	10	-	30	-	-	35	-	-	30	-	-	40
Phoma hibernica Grimes, O'Connors and Cummins	-	-	-	-	-	-	10	25	30	-	20	30	10	20	40	-	20	35	20	20	20	10	10	20
Neocosmospora vasinfecta E.F. Smith	-	-	-	-	-	-	-	-	-	-	15	-	-	20	-	-	20	-	-	20	-	-	20	-
Chaetomium flavum Omvik	-	-	-	-	10	-	-	20	20	-	20	25	-	15	30	20	15	35	-	15	40	-	10	40
Gelasinospora cerealis Dowding	-	-	-	-	10	-	-	10	-	-	-	-	-	-	-	-	10	-	-	10	-	-	10	-
Cephalosporium curtipes Saccardo	20	30	-	30	40	-	35	60	-	40	-	-	10	30	-	20	30	-	-	30	-	-	20	-
										-	15	-	-	15	-	-	-	-	-	15	-	-	-	-
C. asperum Marchal	10	10	-	-	10	-	-	10	-	-	-	-	10	-	-	-	-	-	10	10	-	-	-	-
Monilia [illegible] Gilman & Abbott	10	-	-	25	-	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Monosporium olivaceum Cook & Massee	-	-	10	-	-	10	-	-	20	-	-	30	-	-	10	-	-	20	-	-	10	-	-	20
Trichoderma viride Pers. ex Fr.	-	30	-	10	35	-	20	-	-	-	10	-	-	-	-	-	-	-	-	10	-	-	-	-
Fusarium udum Butler	-	-	65	-	-	70	-	-	80	-	-	100	-	-	100	-	-	100	-	-	80	-	-	70
F. oxysporum Schlecht	20	-	10	25	-	20	30	10	40	-	10	-	-	-	45	20	10	-	-	10	50	10	-	-
Fusidium viride Grove	-	-	-	-	10	-	-	20	-	10	20	-	10	10	-	-	-	-	-	10	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	30	10	20	35	-	-	40	-	25	40	15	30	10	20	35	10	30	40	10	30	45	15	30	50
Curvularia pallescens Boedijn	20	10	10	20	10	15	20	10	15	20	10	20	40	20	30	30	20	40	-	10	45	10	10	40
Alternaria alternata (Fr.) Keissler	30	-	10	25	-	15	20	-	20	20	20	-	15	30	40	20	30	50	30	10	50	20	20	50
Cladosporium herbarum (Persoon) Link	-	-	-	-	-	-	-	-	-	-	10	10	20	30	15	20	10	20	-	20	25	-	10	20
Rhizoctonia solani Kuhn.	-	-	-	-	-	10	-	-	15	-	-	20	-	-	25	10	-	30	10	-	40	-	-	40
Sclerotium rolfsii Saccardo	-	-	-	-	-	10	-	-	10	-	-	-	-	-	40	-	-	40	-	-	40	-	-	45
White sterile mycelium	20	-	-	20	-	-	-	-	-	-	-	-	-	-	-	10	-	-	10	-	-	10	-	-
Yellow sterile mycelium	-	-	10	-	-	10	-	-	20	-	-	-	-	-	10	-	-	10	-	-	-	-	-	-
Black sterile mycelium	-	10	-	-	20	-	-	30	-	-	10	-	-	30	-	-	-	-	-	-	-	-	-	-

*Calculated on the basis of 20 replicates.

NR = Non-rhizosphere, R = Rhizosphere

UP = Uninoculated plants.

IP = Inoculated plants.

ılated and inoculated plants of pigeon pea(cultivar T-21) with F. udum at varying

DAYS													
60		90		120		150		180		210		240	
UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP
30	20	40	10	25	10	15	-	10	-	-	10	-	-
-	30	-	25	-	20	-	20	-	10	-	10	-	10
-	10	-	25	-	20	-	10	-	-	-	-	-	-
30	-	45	-	15	-	10	-	10	-	10	-	10	-
80	55	100	50	90	40	90	35	85	30	80	40	100	45
30	-	30	-	10	-	5	-	10	-	15	-	15	-
60	45	70	40	65	35	65	30	50	25	70	20	80	40
25	20	35	20	35	15	35	10	30	10	25	10	35	15
15	-	20	-	20	-	15	-	15	-	15	-	20	-
5	-	15	-	20	-	20	-	25	-	10	-	10	-
15	10	20	10	30	-	20	-	20	-	15	-	30	-
20	-	40	-	40	-	30	-	30	-	40	-	40	-
-	-	-	15	-	25	-	25	-	30	-	35	-	40
-	-	-	-	10	20	15	30	15	35	25	40	20	40
-	-	-	15	-	20	10	25	10	30	15	35	10	30
30	-	45	-	50	-	45	-	30	-	20	-	20	-
15	-	20	-	25	-	20	-	15	-	15	-	15	-
25	-	30	-	35	-	35	-	40	-	40	-	40	-
10	-	10	-	15	-	20	-	20	-	10	-	15	-
-	55	-	60	-	100	-	100	-	100	-	95	-	90
15	20	20	20	15	25	15	25	10	35	15	40	20	45
-	-	5	5	10	5	10	30	15	35	15	40	10	30
-	-	-	-	10	15	20	25	35	35	40	40	40	40
-	-	-	-	-	15	-	20	-	25	-	30	-	35
-	-	-	-	15	20	20	25	20	30	25	40	25	45
-	-	-	15	-	25	-	30	-	30	-	35	-	35
-	-	-	-	-	10	-	15	-	15	-	15	-	20
-	-	10	5	15	-	-	10	-	20	-	-	10	10
-	20	-	20	-	10	-	10	-	-	-	-	-	-
-	-	-	-	-	-	10	-	-	-	15	-	-	-

2. RHIZOSPHERE AND RHIZOPLANE MYCOFLORA OF DIFFERENT CULTIVARS OF PIGEON PEA PLANTS UNINOCULATED AND INOCULATED WITH *FUSARIUM UDUM* BUTLER.

It is evident from table 8 that 57 fungal species were recorded from the rhizosphere of uninoculated and inoculated plants of eight different cultivars of pigeon pea viz., T-21, No. 148, Pant A-10, ICPL-227, ICPL-42, DL-78-2, BDN-1 and BDN-2. Number of fungal species detected from the rhizosphere of different cultivars i.e., T-21, No. 148, Pant A-10, ICPL-227, ICPL-42, DL-78-2, BDN-1 and BDN-2 were 25, 24, 25, 27, 29, 26, 29 and 24 in the uninoculated plants and 24, 22, 25, 28, 32, 24, 28, and 22 in the inoculated counterparts. Highest number of fungal species was recorded in cultivar ICPL-42 and BDN-1 of uninoculated plants and the lowest in cultivar No. 148 and BDN-2. On the other hand in the rhizosphere of inoculated plants highest number of fungal species was detected in cultivar ICPL-42 and the lowest in cultivar No.148 and BDN-2. Cultivars T-21, No.148, DL-78-2, BDN-1 and BDN-2 harboured higher number of fungal species in the rhizosphere of uninoculated plants in comparison to their inoculated counterparts; on the other hand converse was true in ICPL-227 and ICPL-42. *Aspergillus fumigatus*, *A. flavus*, *A. niger*, *Phoma hibernica*, *Chaetomium magnum* Bainier, *Drechslera australiensis*, *Curvularia pallescens* and *Cladosporium herbarum* were recorded from all the cultivars in the rhizosphere of both uninoculated and inoculated plants. Similarly, some of the fungal forms were isolated from the rhizosphere of both the uninoculated and inoculated plants but were restricted to only few cultivars such as *Rhizopus nigricans* Ehrenberg, ICPL-227 and ICPL-42, *R. arrhizus* Fischer Pant A-10, *Mortierella alpina* T-21 and No. 148, *Aspergillus funiculosus* T-21 and ICPL-227 and *Chaetomium flavum* Pant A-10 and ICPL-42. In the rhizosphere of uninoculated plants *Aspergillus terreus*, *Eusidium viride* and black sterile mycelium were recorded from all the different cultivars; where as *Syncephalastrum racemosum* (Cohn) Schroeter was confined to cultivar BDN-1 and BDN-2; *Aspergillus luchuensis* T-21, No. 148 and ICPL-227; *A. nidulans* T-21 and ICPL-227; *A. sulphureus* No. 148, Pant A-10, ICPL-227 and ICPL-42; *A. ochraceous* Wilhelm ICPL-227 and ICPL-42; *A. sydowi* (Bainier & Sartory) Thom & Church DL-78-2 and BDN-1; *Penicillium chrysogenum* Thom BDN-1; *Neocosmospora vasinfecta* T-21, Pant A-10 and DL-78-2; and *Trichoderma album* No. 148, BDN-1 and BDN-2. *Circinella tenella* was isolated from the rhizosphere of uninoculated plants of all the cultivars except No. 148, BDN-1 and BDN-2; *Aspergillus terricola* except Pant A-10, ICPL-227 and ICPL-42; *Cephalosporium curtipes* except ICPL-227; and *C. roseo-griseum* except ICPL-42. On the other hand in the rhizosphere of inoculated plants *Cunninghamella echinulata*, *Fusarium udum*, *Alternaria alternata*, *Helminthosporium sativum* Pammel, King & Bakke and *Sclerotium* *rolfsii* were recorded from all the cultivars; where as *Mucor racemosus* was confined to cultivar T-21; *Curvularia geniculata* ICPL-42 and DL-78-2; *Nigrospora sphaerica* (Saccardo) Mason No. 148, Pant A-10, ICPL-42 and DL-78-2; *Hormiscium stilbosporum* (Corda) Saccardo ICPL-227, ICPL-42 and BDN-1; *Torula allii* (Harz) Saccardo No. 148, ICPL-227 and DL-78-2; *Rhizoctonia solani* T-21, ICPL-227, ICPL-42 and BDN-1; and yellow sterile mycelium T-21, Pant A-10 and DL-78-2. *Mucor globosus* was recorded in the rhizosphere of inoculated plants of all the cultivars except DL-78-2, BDN-1 and BDN-2; *M. mucedo* (Linne) Brefeld except T-21, No. 148 and Pant A-10; *Pyrenochaeta cajani* except DL-78-2; *Macrophomina phaseoli* (Maublanc) Ashby except T-21, BDN-1 and BDN-2.

The higher frequency value of *Aspergillus fumigatus*, *A. flavus*, *A. niger* was noticed in the rhizosphere of uninoculated plants of all the cultivars in comparison to their inoculated counterparts. On the other hand the higher frequency of *Rhizopus oryzae* was noticed in the rhizosphere of uninoculated plants of cultivar T-21 and ICPL-22 in comparison to their inoculated counterparts; *R. nigricans* in the rhizosphere of ICPL-227, ICPL-42, BDN-1 and BDN-2; *R. arrhizus* Pant A-10; *Aspergillus ustus* (Bainier) Thom & Church ICPL-227 and ICPL-42; *Cephalosporium aspermum* DL-78-2; *Gelasinospora cerealis* T-21, ICPL-227, ICPL-42 and DL-78-2;

Trichoderma viride ICPL-42, DL-78-2, BDN-1 and BDN-2; *T. lignorum* (Tode) Harz BDN-1 and BDN-2; *Aspergillus candidus* of all the cultivars except T-21 and BDN-1; and *Monilia brunnea* of all the cultivars except T-21, No. 148 and DL-78-2. In the rhizosphere of inoculated plants higher frequency of *Phoma hibernica*, *Chaetomium magnum*, *Drechslera australiensis* *Curvularia pallescens* and *Cladosporium herbarum* was noticed in comparison to their uninoculated counterparts from all the cultivars. Similarly, the higher frequency in the rhizosphere of inoculated plants in comparison to their uninoculated counterparts was noticed for *Cunninghamella bertholletiae* Stadel in cultivar BDN-1; *Mortierella alpina* in T-21 and No. 148; *Chaetomium flavum* in Pant A-10 and ICPL-42; *Monosporium olivaceum* in ICPL-227 and ICPL-42; *Fusarium oxysporum* in all the cultivars except BDN-1 and BDN-2.

In the rhizosphere of uninoculated plants the highest frequency value among all cultivars was recorded for *Aspergillus fumigatus* and the lowest for *Aspergillus ustus*, *A. terricola*, *Monosporium olivaceum*, *Trichoderma album*, *Fusarium oxysporum* and black sterile mycelium; however in the rhizosphere of inoculated plants highest frequency value among all cultivars was noticed for *Fusarium udum* and the lowest for *Rhizopus oryzae*, *Mucor globosus*, *M. mucedo*, *Aspergillus candidus*, *A. ustus*, *Monilia brunnea*, *Trichoderma viride*, *Cephalosporium* asperum, Pyrenochaeta cajani, Helminthosporium sativum, Nigrospora sphaerica, Torula allii, Macrophomina phaseoli, and Rhizoctonia solani. The frequency value of Aspergillus fumigatus in uninoculated plants was highest in the rhizosphere of all the cultivars viz., T-21, No. 148, Pant A-10, ICPL-227, ICPL-42, DL-78-2, BDN-1 and BDN-2. On the other hand frequency value of Fusarium udum in the inoculated plants was highest in the rhizosphere of all the cultivars except BDN-1 and BDN-2, in which the highest frequency value was recorded for Aspergillus fumigatus. Lowest frequency value among uninoculated plants were recorded for Mortierella alpina, Aspergillus luchuensis, A. nidulans, A. candidus, A. terricola, Cephalosporium roseo-griseum and Cladosporium herbarum in T-21; A. terreus, A. sulphureus, A. candidus, A. terricola, C. roseo-griseum, Monilia brunnea, Trichoderma album, Curvularia pallescens, Cladosporium herbarum in No.148; A. ustus, T. lignorum, Fusarium oxysporum and C. herbarum in Pant A-10; Monosporium olivaceum in ICPL-227; Fusarium oxysporum in ICPL-42; A. ustus, A. terricola and black sterile mycelium in DL-78-2; Trichoderma album in BDN-1; T. album in BDN-2. On the other hand lowest frequency value in inoculated counterparts was noticed for Rhizopus oryzae, Cunninghamella echinulata, Aspergillus funiculosus, A. niger, Gelasinospora cerealis, Sclerotium rolfsii and yellow sterile mycelium in T-21; A. candidus in No. 148; A. candidus, Nigrospora sphaerica in

Pant A-10; *R. oryzae*, *Mucor globosus*, *A. ustus* and *Macrophomina phaseoli* in ICPL-227; *Monilia brunnea*, *Trichoderma viride*, *Helminthosporium sativum*, *Hormiscium stilbosporum* and *Macrophomina phaseoli* in ICPL-42; *Cephalosporium asperum* *T. viride*, *H. sativum*, and *Macrophomina phaseoli* in DL-78-2; *Hormiscium stilbosporum* and *Rhizoctonia solani* in BDN-1; and *M. mucedo*, *Pyrenochaeta cajani* and *H. sativum* in BDN-2. Highest frequency value of *Fusarium udum* (100) in the rhizosphere of inoculated plants was recorded in cultivar T-21, followed by cultivars No. 148, DL-78-2; ICPL-42, ICPL-227, Pant A-10, BDN-2 and BDN-1 (85, 70, 65, 60, 50, 35 and 30).

A perusal of table 9 indicates that 39 fungal species were isolated from the rhizoplane of eight uninoculated and inoculated cultivars of pigeon pea. Number of fungal species isolated in uninoculated plants from cultivar T-21, No. 148, Pant A-10, ICPL-227, ICPL-42, DL-78-2, BDN-1 and BDN-2 was 20, 20, 21, 19, 23, 21 , 21 and 20; 24, 19, 22, 24, 24, 19, 22 and 21 from inoculated counterparts. In the rhizoplane of uninoculated plants ICPL-227 harboured highest number of fungal species and Pant A-10 the lowest. However, in the rhizoplane of inoculated plants ICPL-227 and ICPL-42 harboured the highest number of fungal species and NO. 148 and DL-78-2 the lowest. Certain fungi viz. *Aspergillus fumigatus*, *A. flavus*, *A. niger*, *Phoma hibernica*, *Chaetomium magnum*, Drechslera australiensis, Curvularia pallescens and Cladosporium herbarum were recorded from the rhizoplane of uninoculated and inoculated plants of all the cultivars. Some of the fungal forms were isolated from the rhizoplane of both the uninoculated and inoculated plants but were restricted to only few cultivars such as Rhizopus nigricans to ICPL-227, ICPL-42, BDN-1 and BDN-2 and Chaetomium flavum Pant A-10 and ICPL-42. In the rhizoplane of uninoculated plants Aspergillus terreus and black sterile mycelium were recorded from all the cultivars; whereas Circinella tenella isolated from all the cultivars except BDN-1 and BDN-2; Aspergillus terricola except Pant A-10, ICPL-227 and ICPL-42; Cephalosporium curtipes except ICPL-227; C. roseo-griseum except ICPL-42, Trichoderma viride except Pant A-10 and ICPL-227. Aspergillus sulphureus was restricted to the rhizoplane of uninoculated plants of cultivar No. 148, Pant A-10, ICPL-227 and ICPL-42, and Neocosmospora vasinfecta T-21, Pant A-10 and DL-78-2. From the rhizoplane of inoculated plants fungi like Cunninghamella echinulata, Fusarium udum, Alternaria alternata, Helminthosporium sativum and Sclerotium rolfsii were recorded from all the cultivars; whereas Mucor globosus was isolated from the inoculated plants of all cultivars except DL-78-2, BDN-1 and BDN-2; Monosporium olivaceum except DL-78-2; and yellow sterile mycelium except ICPL-227 and ICPL-42. Mucor mucedo was restricted to the rhizoplane of inoculated plants of cultivars ICPL-42, DL-78-2, BDN-1 and BDN-2; M. racemosus T-21, and Rhizoctonia solani T-21, ICPL-227 and ICPL-42.

In the rhizoplane of uninoculated plants the higher frequency of Aspergillus fumigatus, A. flavus and A. niger was recorded in comparison to their inoculated counterparts from all the cultivars. The higher frequency of Rhizopus oryzae, in the rhizosphere of uninoculated plants, in comparison to its inoculated counterpart was recorded from cultivars T-21 and ICPL-227; R. nigricans ICPL-42, BDN-1 and BDN-2; R. arrhizus Pant A-10; Mortierella alpina No. 148 and ICPL-42; Aspergillus ustus Pant A-10, ICPL-227, and DL-78-2; Trichoderma viride ICPL-42, DL-78-2, BDN-1 and and BDN-2; Aspergillus candidus from all cultivars except T-21, ICPL-42, DL-78-2; Monilia brunnea except T-21, No. 148 and DL-78-2; Gelasinospora cerealis except No. 148, Pant A-10 and DL-78-2. In the rhizoplane of inoculated plants, the higher frequency of Phoma hibernica, Chaetomium magnum, Drechslera australiensis, Curvularia pallescens and Cladosporium herbarum was recorded in comparison to their uninoculated counterparts from all the cultivars. Higher frequency in the rhizoplane of inoculated plants in comparison to their uninoculated counterparts was recorded for Chaetomium flavum from Pant A-10 and ICPL-42; and Monosporium olivaceum ICPL-42.

In the rhizoplane of uninoculated plant the highest frequency value was noticed for Aspergillus fumigatus and the lowest for Neocosmospora vasinfecta, Chaetomium magnum, Monosporium olivaceum, Curvularia pallescens and Cladosporium herbarum among all the cultivars. However, among the rhizoplane of inoculated plants highest frequency value was recorded for Fusarium udum and the lowest for Mucor globosus, Aspergillus candidus, A. ustus, Pyrenochaeta cajani, Trichoderma viride, Helminthosporium sativum and yellow sterile mycelium. The frequency value of Aspergillus fumigatus, in the rhizoplane of uninoculated plants was highest in all the cultivars viz., T-21, No. 148, Pant A-10 ICPL-227, ICPL-42, DL-78-2, BDN-1 and BDN-2. On the other hand frequency value of Fusarium udum was highest in the rhizoplane of inoculated plants in all the cultivars except BDN-1 and BDN-2, in which the highest frequency value was recorded for Aspergillus fumigatus. Lowest frequency value among uninoculated plants were recorded for Neocosmospora vasinfecta, Cephalosporium roseo-griseum and Curvularia pallescens in T-21; C. pallescens in No. 148, N. vasinfecta and Chaetomium magnum in Pant A-10; Cladosporium herbarum in ICPL-227; Monosporium olivaceum in ICPL-42; Aspergillus terricola and C. herbarum in DL-78-2; Phoma hibernica and C. magnum in BDN-1; Aspergillus terricola, P. hibernica,

C. magnum and Cladosporium herbarum in BDN-2. On the other hand lowest frequency value in inoculated counterparts was noticed for Mucor globosus in T-21; Aspergillus candidus and yellow sterile mycelium in No. 148; M. globosus in Pant A-10; M. globosus, Aspergillus flavus, A. candidus and A. ustus in ICPL-227; M. globosus in ICPL-42; A. ustus, Pyrenochaeta cajani in DL-78-2; M. mucedo, Pyrenochaeta cajani, Phoma hibernica, Monilia brunnea, Gelasinospora cerealis, Helminthosporium sativum and Sclerotium rolfsii in BDN-1; H. sativum in BDN-2. The highest frequency value of Fusarium udum in the rhizoplane of inoculated plants (100) was recorded in the cultivar T-21; followed by cultivars No. 148, ICPL-42, DL-78-2, ICPL-227, Pant A-10, BDN-2 and BDN-1 (95, 70, 70, 60, 55, 45 and 40).

It is evident from table 6 and fig. 2 that population of fungi recorded from different cultivars of pigeon pea plants viz., T-21, No. 148, Pant A-10, ICPL-227, ICPL-42, DL-78-2, BDN-1 and BDN-2 was 120000, 110000, 85000, 90000, 80000, 100000, 75000 and 85000 in the rhizosphere of uninoculated plants; and 420000, 330000, 136000, 162000, 160000, 230000, 97500 and 119000 in inoculated counterparts respectively. This indicates that rhizosphere of inoculated plants harboured more fungal population in comparison to their uninoculated counterparts. In both the uninoculated and inoculated plants highest population of fungi was recorded in cultivar T-21 and lowest in BDN-1.

Table 7 shows that among uninoculated plants the concentration (mg/100 mg of dry sample) of total free amino acids from root extract of T-21, No. 148, Pant A-10, ICPL-227, ICPL-42, DL-78-2, BDN-1 and BDN-2 was 0.67, 0.70, 1.21, 1.11, 0.95, 0.93, 1.67 and 1.48; from inoculated plants 0.88, 0.95, 1.66, 1.51, 1.33, 1.28, 2.32 and 2.09 respectively. Similarly, the concentration of total phenols was 1.35, 1.45, 1.51, 2.61, 2.23, 2.18, 3.91 and 3.46 in the roots of uninoculated plants and 1.80, 1.93, 2.00, 3.45, 2.94, 2.87, 5.14 and 4.54 in the roots of inoculated plants; the concentration of o-dihydroxy phenols was 0.120, 0.128, 0.133, 0.229, 0.195, 0.190, 0.340, 0.300 in uninoculated and 0.156, 0.166, 0.172, 0.296, 0.252, 0.245, 0.438 and 0.386 in the roots of inoculated plants; and the concentration of total sugars was 3.10, 2.88, 2.76, 1.59, 1.86, 1.81, 1.00 and 1.13 in uninoculated and 3.92, 3.64, 3.42, 2.00, 2.33, 2.26, 1.24 and 1.40 respectively in the roots of inoculated counterparts. From the above results it is clear that the concentration of total free amino acids, phenols, o-dihydroxy phenols and sugars were higher in the roots of inoculated plants in comparison to their uninoculated counterparts in all the cultivars. The highest concentration of total free amino acids, phenols and o-dihydroxy phenols was recorded in

BDN-1 and the lowest in T-21 among all the cultivars, but the converse was true in the case of total sugars. Those cultivars harboured higher number of fungi and higher frequency of *Fusarium udum* in the rhizosphere, in comparison to other cultivars, had low concentration of total free amino acids, phenols and o-dihydroxy phenols but higher concentration of total sugars in their roots. Contrary to this, those cultivars harboured lower number of fungi and lower frequency of *Fusarium udum* in the rhizosphere, in comparison to other cultivars, had higher concentrations of total free amino acid, phenols and o-dihydroxy phenols but lower concentration of total sugars in their roots.

It is evident from the above results that qualitative and quantitative differences in the rhizosphere and rhizoplane mycoflora of different cultivars of pigeon pea existed in both uninoculated and inoculated plants. Effect of cultivars was significant at 5% and 1% level. The rhizosphere of inoculated plants of all the cultivars harboured more fungal population in comparison to their uninoculated counterparts. The highest rhizosphere population was noticed in the cultivar T-21 and the lowest in BDN-1 in both the uninoculated and inoculated plants. Similarly, the highest frequency of wilt pathogen *Fusarium udum* was recorded in T-21 and the lowest in BDN-1. The roots of different cultivars exhibited differences in their biochemical nature. Cultivars which harboured higher number of fungi and higher frequency of *Fusarium udum* in the rhizosphere, in comparison to other cultivars, had low concentrations of total free amino acids, phenols and o-dihydroxy phenols but higher concentration of total sugars in their roots. On the other hand, those cultivars harboured lower number of fungi and lower frequency of *Fusarium udum* in the rhizosphere, in comparison to other cultivars, had higher concentration of total free amino acid, phenols and o-dihydroxy phenols but lower concentration of total sugars in their roots.

FIG. 2. Population of fungi in the rhizosphere of uninoculated and inoculated plants (with <u>Fusarium udum</u> Butler) of different cultivars of pigeon pea.

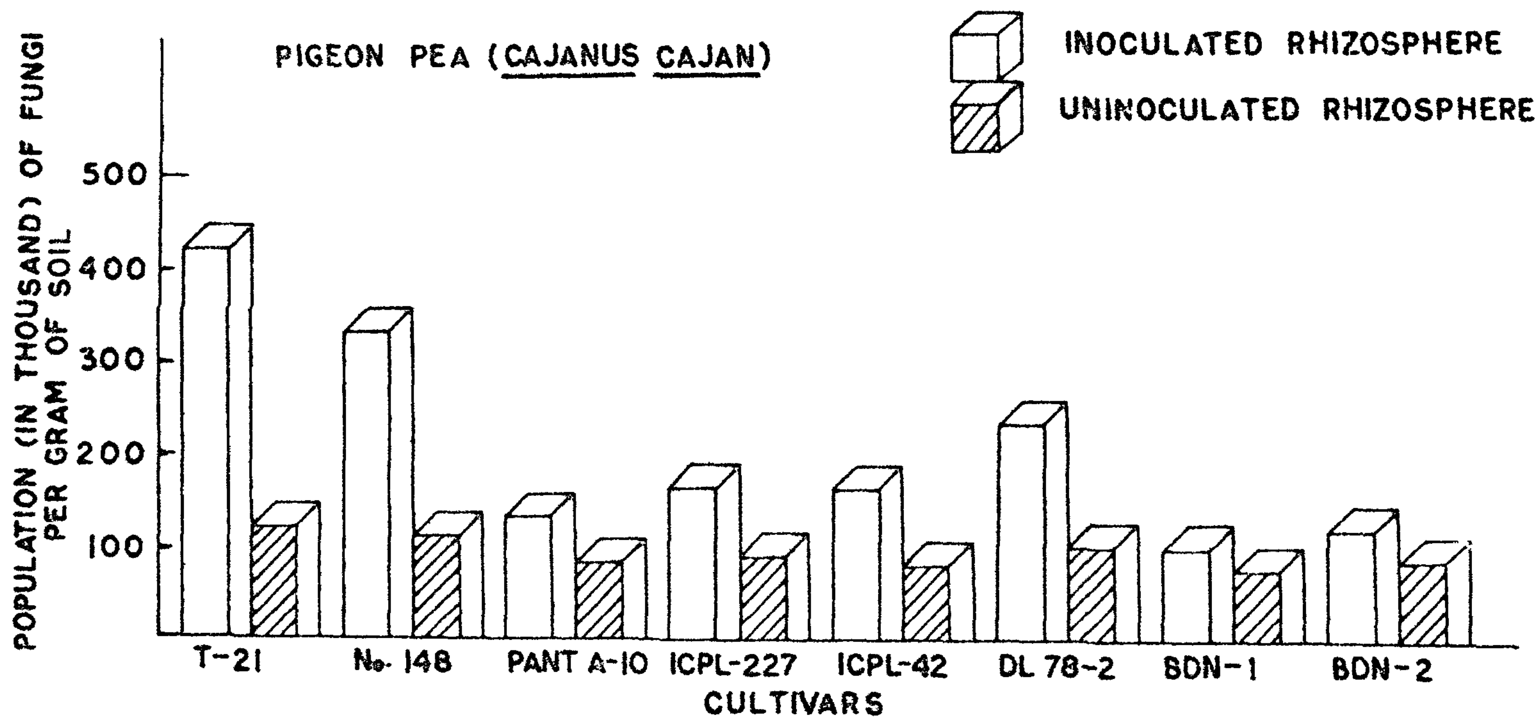

PIGEON PEA (CAJANUS CAJAN)
INOCULATED RHIZOSPHERE
UNINOCULATED RHIZOSPHERE
POPULATION (IN THOUSAND) OF FUNGI PER GRAM OF SOIL
500
400
300
200
100
T-21
No. 148
PANT A-10
ICPL-227
ICPL-42
DL 78-2
BDN-1
BDN-2
CULTIVARS

FIG.2

TABLE 6. Population of fungi (per gram of soil) in the rhizosphere of different cultivars of uninoculated and inoculated pigeon pea plants with *F. udum*.

Cultivars	Rhizosphere	
	Uninoculated plants	Inoculated plants
T-21	120*	420
No. 148	110	330
Pant A-10	85	136
ICPL- 227	90	162
ICPL- 42	80	160
DL-78-2	100	230
BDN-1	75	97.5
BDN-2	85	119
L.S.D. at 5%	1.02015	2.55038
L.S.D. at 1%	1.41585	3.53961

*in thousand.

TABLE 7. Total free amino acids, phenols, o-dihydroxy phenols and sugars concentrations (in mg/100 mg of dry sample) in the roots of uninoculated and inoculated plants of different cultivars of pigeon pea with *F. udum*.

Cultivars	Free amino acids		Phenols		O-dihydroxy phenols		Sugars	
	UP	IP	UP	IP	UP	IP	UP	IP
T-21	0.67	0.88	1.35	1.80	0.120	0.156	3.10	3.92
No. 148	0.70	0.95	1.45	1.93	0.128	0.166	2.88	3.64
Pant A-10	1.21	1.66	1.51	2.00	0.133	0.172	2.76	3.48
ICPL - 227	1.11	1.51	2.61	3.45	0.229	0.296	1.59	2.00
ICPL - 42	0.95	1.33	2.23	2.94	0.195	0.252	1.86	2.33
DL - 78-2	0.93	1.28	2.18	2.87	0.190	0.245	1.81	2.26
BDN -1	1.67	2.32	3.91	5.14	0.340	0.438	1.00	1.24
BDN -2	1.48	2.09	3.46	4.54	0.300	0.386	1.13	1.40
L.S.D. at 5%	0.02807	0.01815	0.02298	0.05312	0.00261	0.00291	0.09995	0.11461
L.S.D. at 1%	0.03896	0.02519	0.03190	0.07372	0.00362	0.00404	0.13873	0.15906

UP = Uninoculated plants. IP = Inoculated plants.

TABLE 8. Frequency (percentage) of fungi in the rhizosphere of diferent cultivars of uninoculated and inoculated pigeon pea plants with *F. udum*.

Fungi isolated	Cultivars															
	T-21		No. 148		Pant A-10		ICPL-227		ICPL-42		DL-78-2		BDN-1		BDN-2	
	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP
Rhizopus oryzae Went & Gerlings	20*	10	20	-	-	-	10	5	10	10	10	10	20	-	20	-
R. nigricans Ehrenberg	-	-	-	-	-	-	15	15	20	10	-	-	20	15	20	15
R. arrhizus Fischer	-	-	-	-	20	10	-	-	-	-	-	-	-	-	-	-
Cunninghamella echinulata Thaxter	-	10	-	15	-	15	-	15	-	20	-	35	-	25	-	25
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	15	20	-	-
Mucor globosus Fischer	-	20	-	25	-	10	-	5	-	10	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	10	-	15	-	15	-	10	-	5
M. racemosus Fresenius	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	10	20	15	25	-	-	-	-	10	20	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	20	-	-	-	15	-	20	-	25	-	10	-	-	-	-	-
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	-	15	-
Aspergillus fumigatus Fresenius	60	30	70	30	80	40	50	45	65	30	70	35	85	70	90	60
A. funiculosus G. Smith	25	10	-	-	-	-	20	15	-	-	-	-	10	10	-	-
A. flavus Link	50	20	40	10	70	25	30	10	40	15	50	20	70	55	75	50
A. niger van Tieghem	30	10	15	10	25	15	20	10	25	10	30	15	60	40	60	35
A. luchuensis Inui	10	-	15	-	-	-	20	-	-	-	-	-	-	-	-	-
A. terreus Thom	20	-	10	-	15	-	25	-	30	-	10	-	30	-	30	-
A. nidulans (Eidam) Winter	10	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church.	-	-	10	-	20	-	15	-	10	-	-	-	-	-	-	-
A. candidus Link.	10	-	10	5	15	5	25	10	15	10	30	10	25	25	20	10
A. ustus (Bainier) Thom & Church	-	-	-	-	10	10	20	5	15	10	5	-	15	15	-	-
A. terricola Marchal	10	-	10	-	-	-	-	-	-	-	5	-	10	-	15	-
A. ochraceous Wilhelm	-	-	-	-	-	-	10	-	15	-	-	-	-	-	-	-
A. sydowi (Bainier & Sartory) Thom & Church	-	-	-	-	-	-	-	-	-	-	10	-	15	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
Pyrenochaeta cajani Singh & Pavgi		30		20		10		10		15				10		5
Phoma hibernica Grimes, O'Connor & Cummins	20	40	15	40	20	30	25	25	20	30	20	35	10	15	10	15
Neocosmospora vasinfecta E.F. Smith	20	-	-	-	15	-	-	-	-	-	20	-	-	-	-	-
Chaetomium magnum Bainier	20	30	30	50	15	20	10	20	10	30	10	25	10	15	10	25
C. flavum Omvik	-	-	-	-	20	30	-	-	15	20	-	-	-	-	-	-
Gelasinospora cereallis Dowding	30	10	40	-	15	-	25	20	30	15	35	15	10	10	10	10
Cephalosporium curtipes Saccardo	15	-	25	-	30	-	-	-	20	-	20	-	40	-	40	-
C. roseo-griseum Saksena	10	-	10	-	20	-	30	-	-	-	10	-	10	-	20	-
C. aspermum Marchal	-	-	-	-	-	-	-	-	10	-	15	5	-	-	-	-
Monilia brunnea Gilman & Abbott	-	-	10	-	20	15	15	10	10	5	10	-	20	10	20	10
Monosporium olivaceum Cooke & Massee	-	15	-	15	-	20	5	25	20	35	-	-	-	20	-	15
Trichoderma viride Pers. ex Fr.	25	-	25	-	-	-	-	-	10	5	10	5	40	35	35	25
T. lignorum (Tode) Harz	-	-	-	-	10	-	15	-	15	-	10	-	15	10	15	10
T. album Preuss	-	-	10	-	-	-	-	-	-	-	-	-	5	-	5	-
Fusarium udum Butler	-	100	-	85	-	50	-	60	-	65	-	70	-	30	-	35
F. oxysporum Schlecht	20	40	15	30	10	20	10	15	5	10	20	30	10	10	-	-
Fusidium viride Grove	30	-	20	-	15	-	10	-	20	-	15	-	15	-	25	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	20	30	20	45	15	30	20	40	10	40	15	30	10	20	10	15
Curvularia Pallescens Boedijn	30	50	10	50	20	45	20	40	30	40	30	35	40	45	45	50
C. geniculata (Tracy - Earle) Boedijn	-	-	-	-	-	-	-	-	-	20	-	15	-	-	-	-
Alternaria alternata (Fr.) Keissler	-	20	-	10	-	30	-	10	-	15	-	10	-	15	-	10
Helminthosporium sativum Pammel, King & Bakke	-	15	-	20	-	15	-	-	-	5	-	5	-	10	-	5
Cladosporium herbarum (Persoon) Link	10	35	10	35	10	35	10	35	15	30	20	25	10	20	10	20
Nigrospora spharica (Saccardo) Mason	-	-	-	10	-	5	-	-	-	15	-	10	-	-	-	-
Cormiscium stilbosporum (Corda) Saccardo	-	-	-	-	-	-	-	20	-	5	-	-	-	5	-	-
Torula allii (Harz) Saccardo	-	-	-	25	-	-	-	30	-	-	-	30	-	-	-	-
Macrophomina phaseoli (Maublanc) Ashby	-	-	-	5	-	10	-	5	-	5	-	5	-	-	-	-
Rhizoctonia solani Kuhn	-	20	-	-	-	-	-	10	-	10	-	-	-	5	-	-
Sclerotium rolfsii Saccardo	-	10	-	10	-	10	-	10	-	10	-	10	-	10	-	10
White sterile mycelium	-	-	-	-	15	-	20	-	10	-	-	-	15	-	20	-
Yellow sterile mycelium	-	10	-	-	-	20	-	-	-	-	-	10	-	-	-	-
Black sterile mycelium	15	-	20	-	15	-	10	-	5	-	5	-	25	-	25	-

*Calculated on the basis of 20 replicates.

UP = Uninoculated plants.

IP = Inoculated plants.

TABLE 9. Frequency (percentage) of fungi in the rhizosphere of [illegible]t cultivars of uninoculated and inoculated pigeon pea plants with *F. udum*.

Fungi isolated	T-21		148	Pant A-10		ICPL-227		ICPL-42		DL-78-2		BDN-1		BDN-2	
	UP	IP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP
Rhizopus oryzae Went & Gerlings	30*	15	-	-	-	25	10	20	20	15	15	15	-	25	-
R. nigricans Ehrenberg	-	-	-	-	-	30	30	30	10	-	-	30	20	30	20
R. arrhizus Fischer	-	-	-	45	15	-	-	-	-	-	-	-	-	-	-
Cunninghamella echinulata Thaxter	-	10	15	-	20	-	25	-	25	-	35	-	40	-	40
Mucor globosus Fischer	-	5	10	-	5	-	5	-	5	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	10	-	10	-	15	-	20
M. racemosus Fresenius	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	20	-	25	-	-	-	-	30	20	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	40	-	-	45	-	30	-	35	-	20	-	-	-	-	-
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	40	-	40	-
Aspergillus fumigatus Fresenius	60	30	40	80	30	60	25	60	40	65	40	100	60	100	70
A. flavus Link	55	15	10	75	30	40	5	45	10	60	25	80	50	85	60
A. niger van Tieghem	40	15	10	30	10	25	10	30	15	40	20	70	35	70	35
A. terreus Thom	30	-	-	25	-	30	-	40	-	20	-	40	-	45	-
A. sulphureus (Fresenius) Thom & Church	-	-	-	40	-	35	-	20	-	-	-	-	-	-	-
A. candidus Link	25	-	5	35	10	40	5	30	-	35	-	50	40	30	15
A. ustus (Bainier) Thom & Church	-	-	-	20	10	30	5	15	-	20	5	20	20	-	-
A. terricola Marchal	20	-	-	-	-	-	-	-	-	10	-	20	-	15	-
Pyrenochaeta cajani Singh & Pavgi	-	50	40	-	20	-	15	-	20	-	5	-	15	-	15
Phoma hibernica Grimes, O'Connor & Cummins	15	20	25	20	40	15	35	15	40	15	20	15	15	15	20
Neocosmospora vasinfecta E.F. Smith	10	-	-	5	-	-	-	-	-	15	-	-	-	-	-
Chaetomium magnum Bainier	15	35	30	5	35	10	40	20	45	25	40	15	20	15	25
C. flavum Omvik	-	-	-	20	40	-	-	15	25	-	-	-	-	-	-
Gelasinospora cerealis Dowding	30	10	-	20	-	30	15	35	20	25	25	25	15	25	20
Cephalosporium curtipes Saccardo	20	-	-	35	-	-	-	25	-	30	-	55	-	50	-
C. roseo-griseum Saksena	10	-	-	15	-	25	-	-	-	20	-	30	-	30	-
Monilia brunnea Gilman & Abbott	-	-	-	25	15	30	10	20	10	20	-	30	15	30	10
Monosporium olivacium Cooke & Massee	-	20	20	-	15	-	20	5	20	-	-	-	20	-	10
Trichoderma viride Pers. ex Fr.	35	-	-	-	-	-	-	40	10	35	5	50	35	40	30
Fusarium udum Butler	-	100	95	-	55	-	60	-	70	-	70	-	40	-	45
Drechslera australiensis Subram.& Jain ex.M.B.Ellis	15	35	40	10	20	10	35	15	30	25	25	20	30	25	30
Curvularia pallescens Boedijn	10	40	35	15	25	15	30	20	35	30	40	20	30	25	30
Alternaria alternata (Fr.) Keissler	-	40	25	-	20	-	25	-	20	-	15	-	20	-	25
Helminthosporium sativum Pammel, King & Bakke	-	20	20	-	15	-	10	-	10	-	10	-	15	-	5
Cladosporium herbarum (Persoon) Link	15	40	30	20	30	5	15	10	20	10	30	20	25	15	20
Rhizoctonia solani Kuhn	-	40	-	-	-	-	20	-	25	-	-	-	-	-	-
Sclerotium rolfsii Saccardo	-	15	30	-	30	-	10	-	15	-	20	-	15	-	15
Yellow sterile mycelium	-	20	5	-	25	-	-	-	-	-	15	-	20	-	20
Black sterile mycelium	30	-	-	45	-	30	-	30	-	40	-	50	-	45	-

*Calculated on the basis of 20 replicates.

UP = Uninoculated plants.

IP = Inoculated plants.

3. <u>RHIZOSPHERE AND RHIZOPLANE MYCOFLORA OF UNINOCULATED AND INOCULATED PLANTS (WITH FUSARIUM UDUM BUTLER) OF PIGEON PEA CULTIVARS T-21 and BDN-1 IN RELATION TO FOLIAR SPRAY</u>.

(a) <u>Growth regulators</u>:

A perusal of tables 11, 13, 15, 17 and 19 indicates that number of fungal species isolated from the rhizosphere of pigeon pea sprayed with 100 ppm of indole acetic acid after I, II and III spray was 19, 22, 23 in uninoculated plants and 21, 25, 25 in inoculated counterparts of cultivar T-21, 22, 24, 26 in uninoculated and 23, 26, 25 in inoculated plants of cultivar BDN-1; with 100 ppm of indole butyric acid after I, II and III spray 18, 20, 23 in uninoculated and 21, 24, 24 in inoculated plants of T-21, 22, 23, 26 in uninoculated and 23, 26, 27 in inoculated plants of BDN-1; with 100 ppm of thio-indole butyric acid after I, II and III spray 18, 21, 24 in uninoculated 21, 24, 25 in inoculated plants of T-21, 23, 24, 26 in uninoculated and 23, 26, 28 in inoculated plants of BDN-1; with 100 ppm of gibberellic acid after I, II and III spray 19, 21, 23 in uninoculated and 20, 25, 24 in inoculated plants of T-21, 21, 23, 26 in uninoculated and 23, 27, 28 in inoculated plants of BDN-1; with 100 ppm of maleic hydrazide after I, II and III spray 13, 18, 17 in uninoculated and 20, 23, 21 in inoculated plants of T-21,21, 21, 23 in uninoculated and 23, 22, 20 in inoculated plants of BDN-1 for the corresponding periods as against 18, 20, 23 in uninoculated and 21, 24, 24 in inoculated control plants of T-21, 22, 23, 26 in uninoculated and 23, 26, 26 in inoculated control plants of BDN-1.

From tables 12, 14, 16, 18 and 20, it is evident that number of fungal species isolated from the rhizoplane treated with 100 ppm indole acetic acid after I, II and III spray was 15, 19, 21 in uninoculated plants and 15, 18, 17 in inoculated plants of cultivar T-21, 16, 19, 20 in uninoculated and 15, 22, 20 in inoculated plants of cultivar BDN-1; with 100 ppm of indole butyric acid after I, II and III spray 16, 18, 21 in uninoculated and 14, 17, 18 in inoculated plants of T-21, 16, 18, 20 in uninoculated and 15, 21, 21 in inoculated plants of BDN-1; with 100 ppm of thio-indole butyric acid after I, II and III spray 14, 17, 21 in uninoculated and 14, 16, 17 in inoculated plants of T-21, 16, 18, 20 in uninoculated and 15, 21, 20 in inoculated plants of BDN-1; with 100 ppm of gibberellic acid after I, II and III spray 15, 18, 21 in uninoculated and 15, 16, 17 in inoculated plants of T-21, 15, 17, 19 in uninoculated and 14, 21, 19 in inoculated plants of BDN-1; with 100 ppm of maleic hydrazide after I, II and III spray 14, 16, 16 in uninoculated and 14, 17, 15 in inoculated plants of T-21, 16, 17, 18 in uninoculated and 15, 20, 19 in inoculated plants of BDN-1 for the corresponding periods as against 14, 17, 21 in uninoculated and 14, 16, 17 in inoculated control plants of T-21, 16, 13, 20 in uninoculated and 15, 21, 20 in inoculated control plants of BDN-1.

A perusal of Fig. 3 and 4 and table 10 indicates that the population of fungi in the rhizosphere of plants sprayed with 100 ppm indole acetic acid after I, II and III spray was 75000, 112000, 145000 in uninoculated and 90000, 140000, 210000 in inoculated counterparts of cultivar T-21, 48000, 66000, 88000 in uninoculated and 60000, 85000, 125000 in inoculated plants of cultivar BDN-1; with 100 ppm indole butyric acid after I, II and III spray 73000, 110000, 142000 in uninoculated and 86000, 130000, 202800 in inoculated plants of T-21, 46000, 62000, 84000 in uninoculated and 58000, 80000, 120000 in inoculated plants of BDN-1; with 100 ppm of thio-indole butyric acid after I, II and III spray 74000, 109000, 140000 in uninoculated and 87000, 132000, 205000 in inoculated plants of T-21, 47500, 63900, 84900 in uninoculated and 59000, 82000, 121900 in inoculated plants of BDN-1; with 100 ppm of gibberellic acid after I, II and III spray 73500, 107000, 139000 in uninoculated and 86700, 131800, 206000 in inoculated plants of T-21, 46200, 63000, 83000 in uninoculated and 58500, 81000, 121000 in inoculated plants of BDN-1; with 100 ppm of maleic hydrazide after I, II and III spray, 60000, 50000, 46000 in uninoculated and 82000, 79000, 76000 in inoculated plants of T-21, 38000, 340000, 30000 in uninoculated and

43000, 40000, 38500 in inoculated plants of BDN-1 for the corresponding periods as against 66000, 95000, 130000 in uninoculated and 80000, 120200, 200600 in inoculated control plants of T-21, 40000, 55000, 76000 in uninoculated and 45000, 70000, 110000 in inoculated control plants of BDN-1. However, the population of fungi in the non-rhizosphere for the corresponding periods was 9500, 11500, 12000 respectively.

Table 11 indicates that in the rhizosphere of uninoculated plants of both the cultivars T-21 and BDN-1, frequency of majority of the fungi increased with the application of 100 ppm of indole acetic acid after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. funiculosus, A. niger, A. luchuensis, A. terreus, Cephalosporium curtipes, C. roseo-griseum, Trichoderma viride, Drechslera australiensis, Curvularia pallescens and black sterile mycelium increased after each spray; Aspergillus candidus, Chaetomium flavum and Gelasinospora cerealis after II and III spray; C. magnum after III spray. Other forms followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, R. nigricans, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. funiculosus, A. niger, A. terreus, A. terricola, C. curtipes, C. roseo-griseum, T. viride, D. australiensis, C. pallescens, Alternaria *alternata* and black sterile mycelium increased after each spray *C. flavum* and *C. magnum* after II and III spray; *Cephalosporium aspermum* and *Fusidium viride* after III spray. Rest of the fungi followed a similar pattern. Higher frequency value in the rhizosphere of uninoculated plants of cultivar T-21 with the application of 100 ppm of indole acetic acid spray was recorded for *R. oryzae*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. nidulans*, *A. terricola*, *C. curtipes*, and *T. viride*; and lower frequency value for *A. luchuensis* *A. candidus*, *C. flavum*, *G. cerealis*, *F. viride* and *C. pallescens*. In the cultivar BDN-1, higher frequency value was recorded for *R. oryzae*, *R. nigricans*, *S. racemosum*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terreus*, *A. candidus*, *A. terricola*, *A. sydowi*, *Penicillium chrysogenum*, *C. curtipes*, *T. viride* and black sterile mycelium; and lower frequency value for *C. flavum*, *C. magnum* and *F. viride* (Table 11). In the rhizosphere of inoculated plants of cultivar T-21, sprayed with 100 ppm of indole acetic acid after I, II and III spray, the frequency of *Aspergillus ustus* and *A. terricola* decreased after each spray. On the other hand, the frequency of *R. oryzae*, *C. echinulata*, *Mucor globosus*,, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terreus*, *Fusarium udum*, *D. australiensis*, *C. pallescens*, *A. alternata* and *Helminthosporium sativum* increased after each spray; *C. flavum*, *C. magnum*, *Rhizoctonia solani* and *Sclerotium rolfsii* after II and III spray. Similar pattern was observed in rest of the fungi. In the cultivar BDN-1, the frequency of *Aspergillus candidus* and *A. sydowi* decreased after each spray; *A. ustus* and *A. terricola* after I and II spray. On the other hand, the frequency of *Rhizopus nigricans*, *C. echinulata*, *Mucor mucedo*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terreus*, *T. viride*, *F. udum*, *F. oxysporum*, *D. australiensis*, *C. pallescens*, *A. alternata*, *H. sativum* and yellow sterile mycelium increased after each spray; *C. flavum*, *R. solani* and *S. rolfsii* after II and III spray; *C. magnum*, *C. aspermum* after III spray. A similar pattern was observed in rest of the fungi. Higher frequency value in the rhizosphere of inoculated plants after 100 ppm spray of indole acetic acid was recorded for *A. fumigatus*, *A. flavus*, *A. terreus*, *C. flavum*, *F. udum*, *D. australiensis*, and *H. sativum*; and lower frequency value for *M. globosus*, *A. funiculosus*, *A. candidus*, *A. ustus* , *A. terricola*, *Monosporium olivaceum*, *R. solani* and *S. rolfsii*. In the cultivar BDN-1, higher frequency value was recorded for *Cunninghamella bertholletiae*, *A. fumigatus*, *A. niger*, *F. udum*, *D. australiensis* and *C. pallescens*; and lower frequency value for *A. funiculosus*, *A. terreus*, *A. candidus*, *A. ustus*, *A. sydowi* *T. viride*, *H. sativum*, *R. solani* and *S. rolfsii* (Table 11).

A perusal of table 12 indicates that the frequency of the fungi in the rhizoplane of uninoculated plants of both the cultivars T-21 and BDN-1 increased with the application of

100 ppm of indole acetic acid after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. funiculosus, A. niger, Cephalosporium curtipes, C. roseo-griseum, Trichoderma viride, T. album, Pullularia pullulans (de Bary) Berkhout and black sterile mycelium increased after each spray; A. nidulans, A. candidus, Curvularia pallescens, Drechslera hawaiiensis after II and III spray; D. australiensis, Helminthosporium sativum after III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, R. nigricans, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. funiculosus, A. niger, A. terreus, C. curtipes, C. roseo-griseum, T. viride, T. album, P. pullulans and black sterile mycelium increased after each spray; C. pallescens, Drechslera australiensis, D. hawaiiensis, after II and III spray; H. sativum after III spray. Rest of the fungi followed a similar pattern. Higher frequency value in the rhizoplane of uninoculated plants of cultivar T-21 after 100 ppm of indole acetic acid spray was noticed for C. tenella, A. fumigatus, A. flavus, C. curtipes and black sterile mycelium; and lower frequency value for A. terreus, A. nidulans, Trichoderma album, D. australiensis and D. hawaiiensis. In the cultivar BDN-1 higher frequency value was recorded for R. oryzae, S. racemosum,

A. fumigatus, A. flavus, A. niger, A. terreus, A. candidus, C. curtipes, C. roseo-griseum, T. viride and black sterile mycelium; and lower frequency value for C. pallescens and H. sativum (Table 12). In the rhizoplane of inoculated plants of cultivar T-21, with the application of 100 ppm of indole acetic acid after I, II and III spray, the frequency of A. fumigatus, A. flavus, A. niger, A. nidulans and A. candidus decreased after each spray except A. niger which exhibited higher frequency value after III spray. The frequency of Aspergillus funiculosus and A. luchuensis decreased after I and II spray. On the other hand, the frequency of R. oryzae, Cunninghamella echinulata, Mucor globosus, Fusarium udum, D. australiensis, D. hawaiiensis, Pullularia pullulans and yellow sterile mycelium increased after each spray; C. pallescens, Rhizoctonia solani, Sclerotium rolfsii after II and III spray; H. sativum after III spray. In the cultivar BDN-1, the frequency of A. fumigatus, A. flavus, A. funiculosus, A. niger, A. terreus, A. candidus, T. viride and T. album decreased after each spray. On the other hand, the frequency of Rhizopus nigricans, C. echinulata, C. bertholletiae, Mucor mucedo, F. udum, P. pullulans and yellow sterile mycelium increased after each spray, C. pallescens, D. australiensis D. hawaiiensis, H. sativum, R. solani and S. rolfsii after II and III spray. Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21 after 100 ppm of indole acetic acid spray was recorded for A. fumigatus, F. udum, C. pallescens, H. sativum, P. pullulans and yellow sterile mycelium; and lower frequency value for C. echinulata, A. funiculosus, A. niger, A. luchuensis, A. nidulans and A. candidus. In the cultivar BDN-1, higher frequency value was recorded for F. udum, D. australiensis and P. pullulans and lower frequency value for Aspergillus flavus, A. funiculosus, A. terreus, A. candidus, T. viride and T. album (Table 12).

A perusal of table 13 reveals that in the rhizosphere of uninoculated plants of both the cultivars T-21 and BDN-1, the frequency of most of the fungi increased with the application of 100 ppm of indole butyric acid after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus A. flavus, A. funiculosus, A. niger, A. luchuensis, Cephalosporium curtipes, C. roseo-griseum, Trichoderma viride, Drechslera australiensis, Curvularia pallescens and black sterile mycelium increased after each spray; A. candidus, Chaetomium flavum after II and III spray; C. magnum, Gelasinospora cerealis and Fusidium viride after III spray. A similar pattern was followed by rest of the fungi. In the cultivar BDN-1, the frequency of *R. oryzae*, *R. nigricans*, *Syncephalastrum racemosum*, *A. fumigatus*, *A. flavus*, *A. funiculosus*, *A. niger*, *A. terreus* *C. curtipes*, *T. viride*, *T. lignorum*, *D. australiensis*, *C. pallescens*, *Alternaria alternata* and black sterile mycelium increased after each spray; *C. flavum* after II and III spray; *C. magnum*, *Cephalosporium aspermum*, *E. viride* after III spray. A similar pattern was followed by rest of the fungi. Higher frequency value in the rhizosphere of uninoculated plants of T-21 after 100 ppm of indole butyric acid spray was recorded for *R. oryzae*, *A. fumigatus*, *A. flavus*, *A. nidulans*, *A. terricola*, *C. curtipes*, *T. viride* and black sterile mycelium; and lower frequency value for *A. funiculosus*, *A. candidus*, *C. flavum*, *C. magnum*, *G. cerealis*, *E. viride* and *C. pallescens*. In the cultivar BDN-1, higher frequency value was noticed for *R. oryzae*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terreus*, *A. candidus*, *A. terricola*, *A. sydowi*, *Penicillium chrysogenum*, *C. curtipes*, *C. roseo-griseum*, *T. viride* and black sterile mycelium; and lower frequency value for *C. flavum*, *C. magnum*, *Cephalosporium aspermum*, and *D. australiensis* (Table 13). In the rhizosphere of inoculated plants of T-21, with the application of 100 ppm of indole butyric acid, the frequency of *Aspergillus niger* and *A. ustus* decreased after each spray. On the other hand, the frequency of *R. oryzae*, *Cunninghamella echinulata*, *Mucor globosus*, *A. fumigatus*, *A. flavus*, *A. terreus*, *A. candidus*, Fusarium udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, Helminthosporium sativum and yellow sterile mycelium increased after each spray; A. funiculosus after I and II spray; C. flavum, Rhizoctonia solani, Sclerotium rolfsii after II and III spray; C. magnum after III spray. In the cultivar BDN-1, the frequency of most of the fungi increased such as - Rhizopus nigricans, C. echinulata, C. bertholletiae, Mucor mucedo, A. fumigatus, A. flavus, A. niger, A. terreus, T. viride, F. udum, F. oxysporum, A. alternata and yellow sterile mycelium; A. funiculosus after I and II spray; C. flavum, R. solani, S. rolfsii after II and III spray; C. magnum, Cephalosporium aspermum after III spray. Rest of the fungi followed the same pattern. Higher frequency value in the rhizosphere of inoculated plants of cultivar T-21 after 100 ppm indole butyric acid spray was recorded for C. echinulata, A. fumigatus, A. flavus, C. magnum, F. udum, D. australiensis, A. alternata and H. sativum; and lower frequency value for M. globosus, A. funiculosus, A. candidus, A. ustus, A. terricola and Rhizoctonia solani. In the cultivar BDN-1, higher frequency value was recorded for C. echinulata, A. fumigatus, C. flavum, T. viride, D. australiensis, C. pallescens and A. alternata; and lower frequency value for R. nigricans, A. funiculosus, A. terreus, A. ustus, A. terricola, A. sydowi, C. aspermum, H. sativum, R. solani and S. rolfsii.

It is clear from table 14 that in the rhizoplane of uninoculated plants of cultivar T-21 and BDN-1, the frequency of most of the fungi increased with the application of 100 ppm of indole butyric acid after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Trichoderma viride, Pullularia pullulans and black sterile mycelium increased after each spray; A. candidus, Curvularia pallescens after II and III spray; Drechslera australiensis, D. hawaiiensis, Helminthosporium sativum after III spray. Rest of the forms followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, R. nigricans, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, C. curtipes, T. viride, P. pullulans and black sterile mycelium increased after each spray; C. pallescens, D. australiensis after II and III spray; D. hawaiiensis, H. sativum after III spray. Rest of the fungi showed a similar pattern. Higher frequency value in the rhizoplane of uninoculated plants of cultivar T-21 after 100 ppm indole butyric acid spray was exhibited by A. fumigatus, A. flavus and black sterile mycelium; and lower frequency value for A. luchuensis, A. terreus, A. nidulans, A. candidus, Trichoderma album, C. pallescens, D. australiensis and D. hawaiiensis. In the cultivar BDN-1, higher frequency value was noticed for R. oryzae, R. nigricans, A. fumigatus,

A. flavus, A. niger, A. terreus, A. candidus, C. curtipes, C. roseo-griseum, T. viride and black sterile mycelium; and lower frequency value for C. pallescens (Table 14). In the rhizoplane of inoculated plants of cultivar T-21 and BDN-1 with the application of 100 ppm of indole butyric acid, the frequency of most of the fungi increased after I, II and III spray. In the cultivar T-21, the frequency of R. oryzae, Mucor globosus, A. fumigatus, A. flavus, A. funiculosus, A. niger, Fusarium udum, D. australiensis, D. hawaiiensis, P. pullulans and yellow sterile mycelium increased after each spray; A. luchuensis after I spray; A. nidulans, C. pallescens, Rhizoctonia solani, Sclerotium rolfsii after II and III spray; H. sativum after III spray. A similar pattern was noticed in other forms also. In the cultivar BDN-1, the frequency of Rhizopus nigricans, Cunninghamella echinulata, Mucor mucedo, A. fumigatus, A. flavus, A. niger, A. terreus, T. viride, F. udum, P. pullulans and yellow sterile mycelium increased after each spray; C. pallescens, D. australiensis D. hawaiiensis, H. sativum, R. solani, S. rolfsii after II and III spray. Rest of the fungi followed similar pattern. Higher frequency value in the rhizoplane of inoculated palnts of cultivar T-21 after 100 ppm of indole butyric acid was exhibited by A. fumigatus, A. flavus, F. udum, D. australiensis H. sativum, P. pullulans and yellow sterile mycelium; and lower frequency value by C. echinulata, A. funiculosus, A. niger,

A. luchuensis, A. nidulans, A. candidus, and D. hawaiiensis. In the cultivar BDN-1, higher frequency value was recorded for A. fumigatus, A. niger, F. udum, C. pallescens, D. australiensis, D. hawaiiensis, P. pullulans and yellow sterile mycelium; and lower frequency value for R. nigricans C. echinulata, C. bertholletiae, A. funiculosus, A. terreus A. candidus, T. viride and T. album (Table 14).

Table 15 reveals that with the application of 100 ppm of thio-indole butyric acid after I, II and III spray, the frequency of most of the fungi increased in the rhizosphere of uninoculated plants of cultivar T-21 and BDN-1. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, A. luchuensis, A. terreus, Cephalosporium curtipes, C. roseo-griseum, Trichoderma viride, Drechslera australiensis, Curvularia pallescens and black sterile mycelium increased after each spray; R. nigricans, A. candidus after I and II spray; Chaetomium flavum after II and III spray; C. magnum Gelasinospora cerealis, Fusidium viride after III spray. A similar pattern was noticed in rest of the fungi. In the cultivar BDN-1, the frequency of R. oryzae, R. nigricans, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, A. luchuensis, A. terreus, C. curtipes, T. viride, D. australiensis, C. pallescens, Alternaria alternata and black sterile mycelium increased after each spray; C. flavum after II and III spray; C. magnum and E. viride after III spray. Rest of the fungi followed a similar pattern. Higher frequency value in the rhizosphere of uninoculated plants of cultivar T-21 after 100 ppm of thio-indole butyric acid was shown by A. fumigatus, A. flavus, A. nidulans, A. terricola, C. curtipes and T. viride; and lower frequency value by R. nigricans, A. candidus, C. flavum, C. magnum, G. cerealis, E. viride and D. australiensis. In the cultivar BDN-1, higher frequency value was recorded for R. oryzae, R. nigricans, S. racemosum, A. fumigatus, A. flavus, A. funiculosus, A. niger, A. terreus, A. candidus, A. ustus, A. terricola, A. sydowi, Penicillium chrysogenum, C. curtipes, C. roseo-griseum, T. viride and black sterile mycelium; and lower frequency value for C. flavum, C. magnum, Cephalosporium aspermum, T. lignorum, D. australiensis and C. pallescens (Table 15). In the rhizosphere of inoculated plants of cultivars T-21 and BDN-1, with the applications of 100 ppm of thio-indole butyric acid after I, II and III spray, the frequency of most of the fungi increased. In the cultivar T-21, the frequency of R. oryzae, Cunninghamella echinulata A. fumigatus, A. flavus, A. niger, A. candidus, A. ustus, Monosporium olivaceum, Fusarium udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, Helminthosporium sativum and yellow sterile mycelium increased after each spray; C. flavum, Rhizoctonia solani and *Sclerotium rolfsii* after II and III spray; *C. magnum* after III spray. Rest of the forms showed a similar pattern. In the cultivar BDN-1, the frequency of *R. nigricans*, *C. echinulata*, *Mucor mucedo*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terreus*, *T. viride*, *F. udum*, *F. oxysporum*, *D. australiensis*, *C. pallescens*, *A. alternata*, *H. sativum*, *Hormiscium stilbosporum* and yellow sterile mycelium increased after each spray; *C. flavum*, *R. solani*, *S. rolfsii*, after II and III spray; *C. magnum*, *Cephalosporium aspermum* after III spray. Rest of the fungi showed a similar pattern (Table 15). *C. echinulata*, *A. fumigatus*, *C. magnum*, *F. udum*, *D. australiensis* and yellow sterile mycelium exhibited higher frequency value in the rhizosphere of inoculated plants of cultivar T-21 after 100 ppm of thio-indole butyric acid spray; and *M. globosus*, *A. funiculosus* and *A. candidus* lower frequency value. In the cultivar BDN-1, higher frequency value was noticed for *A. fumigatus*, *A. niger*, *D. australiensis* and *C. pallescens*; and lower frequency value for *R. nigricans*, *C. echinulata*, *C. bertholletiae*, *M. mucedo*, *A. funiculosus*, *A. terreus*, *A. candidus*, *A. ustus*, *A. terricola*, *A. sydowi*, *Cephalosporium aspermum*, *H. sativum*, *R. solani* and *S. rolfsii*.

Table 16 indicates that the frequency of majority of the fungi in the rhizoplane of uninoculated plants of both the cultivars T-21 and BDN-1 increased with the application of thio-indole butyric acid after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. funiculosus, A. niger, Cephalosporium curtipes, Trichoderma viride, Pullularia pullulans and black sterile mycelium increased after each spray; A. nidulans, A. candidus, Curvularia pallescens after II and III spray; A. terreus, Drechslera australiensis, D. hawaiiensis, Helminthosporium sativum after III spray. A similar pattern was followed by rest of the fungi. In the cultivar BDN-1, the frequency of R. oryzae, R. nigricans, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. funiculosus, A. niger, C. curtipes, T. viride, P. pullulans and black sterile mycelium increased after each spray; C. pallescens, D. australiensis after II and III spray; D. hawaiiensis, H. sativum after III spray. Higher frequency value in the rhizoplane of uninoculated plants of cultivar T-21 after 100 ppm of thio-indole butyric acid was exhibited by C. tenella, A. fumigatus, A. flavus, A. funiculosus, C. curtipes, T. viride, P. pullulans and black sterile mycelium, and lower frequency value by A. terreus, A. nidulans, C. pallescens, D. australiensis and D. hawaiiensis. In the cultivar BDN-1, higher frequency value was recorded for R. oryzae, Cunninghamella bertholletiae, S. racemosum, A. fumigatus, A. flavus, A. funiculosus, A. niger, A. terreus, A. candidus, C. curtipes, C. roseo-griseum, T. viride and black sterile mycelium; and lower frequency value for

C. pallescens and H. sativum (Table 16). In the rhizoplane of inoculated plants of cultivar T-21, with the application of 100 ppm of thio-indole butyric acid after I, II and III spray, the frequency of Aspergillus nidulans decreased after II and III spray. On the other hand, the frequency of R. oryzae, Cunninghamella echinulata, Mucor globosus, A. fumigatus, A. flavus, A. niger, A. candidus, Fusarium udum, D. australiensis, D. hawaiiensis, P. pullulans and yellow sterile mycelium increased after each spray; A. funiculosus, A. luchuensis after I spray; C. pallescens, Rhizoctonia solani, Sclerotium rolfsii after II and III spray; H. sativum after III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of C. echinulata decreased after each spray except after I spray. On the other hand, the frequency of Rhizopus nigricans, Mucor mucedo, A. fumigatus, A. flavus, A. niger, A. candidus, T. viride, T. album, F. udum, P. pullulans and yellow sterile mycelium increased after each spray; A. funiculosus after I and II spray; C. pallescens, D. australiensis, H. sativum, R. solani and S. rolfsii after II and III spray. Rest of the fungi followed a similar pattern. Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21 after 100 ppm of thio-indole butyric acid was exhibited by A. fumigatus, A. flavus, A. funiculosus, F. udum, H. sativum, *P. pullulans* and yellow sterioe mycelium; and lower frequency value by *A. niger*, *A. luchuensis*, *A. nidulans*, *A. candidus*, and *Drechslera hawaiiensis*. In the cultivar BDN-1, higher frequency value was noticed for *A. fumigatus*, *A. niger*, *C. pallescens* and yellow sterile mycelium; and lower frequency value for *R. nigricans*, *C. echinulata*, *C. bertholletiae*, *A. terreus*, *A. candidus*, *T. viride* and *T. album* (Table 16).

A perusal of table 17 reveals that the frequency of majority of the fungi from the rhizosphere of uninoculated plants of both the cultivars T-21 and BDN-1 increased with the application of 100 ppm of gibberellic acid after I, II and III spray. In the cultivar T-21, the frequency of *Rhizopus oryzae*, *Circinella tenella*, *Aspergillus fumigatus*, *A. flavus*, *A. niger*, *A. terreus*, *Cephalosporium curtipes*, *C. roseo-griseum*, *Trichoderma viride*, *Drechslera australiensis*, *Curvularia pallescens* and black sterile mycelium increased after each spray; *Chaetomium flavum*, *C. magnum*, after II and III spray; *R. nigricans*, *Gelasinospora cerealis*, *Fusidium viride* after III spray. A similar pattern was followed by other fungi also. In the cultivar BDN-1, the frequency of *R. oryzae*, *Cunninghamella bertholletiae*, *Syncephalastrum racemosum*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terreus*, *C. curtipes*, *T. viride*, *D. australiensis*, *C. pallescens*, *Alternaria alternata* and black sterile mycelium increased after each spray; *C. flavum*,

C. magnum after II and III spray; C. aspermum, Gelasinospora cerealis, and Fusidium viride after III spray. A similar pattern was noticed in other forms. Higher frequency in the rhizosphere of uninoculated plants of cultivar T-21, after 100 ppm of gibberellic acid spray, was shown by C. tenella, A. fumigatus, A. flavus, A. nidulans, A. terricola, C. curtipes, C. roseo-griseum and T. viride; and lower by R. nigricans, A. funiculosus, A. candidus, C. flavum, C. aspermum, G. cerealis and F. viride. In the cultivar BDN-1, higher frequency value was recorded for R. oryzae, S. racemosum, A. fumigatus, A. flavus, A. niger, A. terreus A. candidus, A. terricola, A. sydowi, C. curtipes, C. roseo-griseum, T. viride and black sterile mycelium; and lower frequency value for C. flavum, C. aspermum, G. cerealis T. lignorum and D. australiensis (Table 17). In the rhizosphere of inoculated plants of both the cultivars T-21 and BDN-1, with the application of 100 ppm of gibberellic acid after I, II and III spray, the frequency of majority of the fungi increased after each spray. In the cultivar T-21, the frequency of R. oryzae, Mucor globosus, A. fumigatus, A. flavus, A. niger, A. candidus, A. ustus, Fusarium udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, Helminthosporium sativum and yellow sterile mycelium increased after each spray; A. funiculosus after I and II spray; M. racemosus, C. flavum, C. magnum, Rhizoctonia solani, Sclerotium rolfsii after II and III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of R. nigricans, Mucor mucedo, A. fumigatus, A. flavus, A. niger, A. terreus, M. olivaceum, T. viride, F. udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, H. sativum and yellow sterile mycelium increased after each spray; C. flavum, C. magnum, after II and III spray; Cephalosporium aspermum, R. solani and S. rolfsii after III spray. Rest of the forms showed a similar pattern. Higher frequency value in the rhizosphere of inoculated plants of cultivar T-21 after 100 ppm gibberellic acid spray was recorded for Mortierella alpina, A. fumigatus, C. flavum, C. magnum, F. udum, F. oxysporum, D. australiensis and H. sativum; and lower frequency value for R. oryzae, R. nigricans, M. globosus, A. niger, A. candidus, A. terricola, R. solani and S. rolfsii. In the cultivar BDN-1, higher frequency value was noticed for A. fumigatus and D. australiensis, and lower frequency value for R. nigricans, Cunninghamella bertholletiae, A. funiculosus, A. terreus, A. candidus, A. ustus, A. terricola, A. sydowi, R. solani and yellow sterile mycelium.

It is evident from table 18 that the frequency of majority of the fungi in the rhizoplane of uninoculated plants of both the cultivars T-21 and BDN-1 increased with the application of 100 ppm of gibberellic acid after I, II and

III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. funiculosus, A. niger, Cephalosporium curtipes, Trichoderma viride, Pullularia pullulans and black sterile mycelium increased after each spray; A. nidulans, A. candidus, Curvularia pallescens after II and III spray; Drechslera hawaiiensis, Helminthosporium sativum after III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, R. nigricans, Syncephalastrum racemosum, Aspergillus fumigatus, A. flavus, A. niger, A. terreus, C. curtipes, T. viride, P. pullulans and black sterile mycelium increased after each spray; Drechslera australiensis, C. pallescens, after II and III spray; D. hawaiiensis, H. sativum after III spray. Rest of the fungi showed a similar pattern. Higher frequency value in the rhizoplane of uninoculated plants of cultivar T-21 after 100 ppm of gibberellic acid was exhibited by C. tenella, A. fumigatus, A. flavus, C. curtipes, P. pullulans and black sterile mycelium; and lower frequency value by A. terreus, A. nidulans, A. candidus and D. hawaiiensis. In the cultivar BDN-1, higher frequency value was noticed for R. oryzae, R. nigricans, S. racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, A. candidus, C. curtipes and black sterile mycelium; and lower frequency value for D. hawaiiensis, C. pallescens and *Helminthosporium sativum* (Table 18). In the rhizoplane of inoculated plants of both the cultivars T-21 and BDN-1, with the application of 100 ppm of gibberellic acid, the frequency of majority of the fungi increased after I, II and III spray. In the cultivar T-21, the frequency of *R. oryzae*, *Cunninghamella echinulata*, *Mucor globosus*, *A. fumigatus*, *A. flavus*, *A. niger*, *Fusarium udum*, *D. australiensis* and *Sclerotium rolfsii* increased after each spray; *A. funiculosus*, *A. luchuensis* after I spray; *C. pallescens*, *H. sativum*, *Rhizoctonia solani* after II and III spray. A similar pattern was noticed in other fungi. In the cultivar BDN-1, the frequency of *Rhizopus nigricans*, *C. echinulata*, *A. fumigatus*, *A. flavus*, *A. niger*, *T. viride*, *F. udum* and *H. sativum* increased after each spray; *C. bertholletiae*, *A. funiculosus* after I and II spray; *D. australiensis*, *D. hawaiiensis*, *C. pallescens*, *R. solani*, *S. rolfsii* and yellow sterile mycelium after II and III spray. Rest of the fungi followed a similar pattern. Higher frequency in the rhizoplane of inoculated plants of cultivar T-21 after 100 ppm of gibberellic acid spray was shown by *A. fumigatus*, *A. flavus*, *A. funiculosus*, *F. udum*, *D. hawaiiensis*, *H. sativum*, *P. pullulans* and yellow sterile mycelium; and lower frequency value by *C. echinulata*, *A. niger*, *A. nidulans*, *A. candidus*. In the cultivar BDN-1, the higher frequency value was recorded for *Aspergillus flavus*, *A. niger*, *F. udum*, *D. australiensis*,

P. pullulans; and lower frequency value for R. nigricans, C. echinulata, A. funiculosus, A. terreus, A. candidus, T. viride and T. album (Table 18).

It is clear from table 19 that with the application of 100 ppm of maleic hydrazide, the frequency of almost all the fungi in the rhizosphere of uninoculated plants of both the cultivars T-21 and BDN-1 decreased after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Aspergillus fumigatus, A. flavus, A. niger, A. nidulans, Cephalosporium curtipes, Trichoderma viride, Curvularia pallescens and black sterile mycelium decreased after each spray; A. funiculosus after I spray; Circinella tenella, A. terreus, C. aspermum after I and II spray; Chaetomium flavum after II spray; Drechslera australiensis after II and III spray; A. candidus, C. magnum, Gelasinospora cerealis, Fusidium viride after III spray. A similar pattern was noticed in rest of the fungi. In the cultivar BDN-1, the frequency of R. oryzae, R. nigricans, Cunninghamella bertholletiae, A. fumigatus, A. flavus, A. niger, C. curtipes, T. viride, D. australiensis and black sterile mycelium decreased after each spray; A. funiculosus, Alternaria alternata after I and II spray; C. flavum, C. aspermum, T. lignorum, F. viride, after III spray. Same pattern was noticed for other fungi also. Fungi viz. R. oryzae, Aspergillus funiculosus, A. luchuensis, A. sulphureus,

C. flavum, C. magnum, C. curtipes, T. viride and D. australiensis exhibited lower frequency value in the rhizosphere of uninoculated plants of cultivar T-21 after 100 ppm of maleic hydrazide spray. Same pattern was observed by majority of fungi. In the cultivar BDN-1, majority of the fungi showed lower frequency value after 100 ppm maleic hydrazide spray such as - R. oryzae, Syncephalastrum racemosum, A. terreus, A. candidus, A. ustus, C. flavum, Penicillium chrysogenum, C. curtipes, T. viride, F. viride, D. australiensis, A. alternata and yellow sterile mycelium except A. niger (Table 19). In the rhizosphere of inoculated plants of both the cultivars T-21 and BDN-1 with the application of 100 ppm of maleic hydrazide after I, II and III spray, the frequency of majority of the fungi decreased. In the cultivar T-21, the frequency of R. oryzae, Cunninghamella echinulata, A. fumigatus, A. flavus, A. niger, Monosporium olivaceum, Fusarium udum, F. oxysporum, D. australiensis, A. alternata and yellow sterile mycelium decreased after each spray; Mucor globosus, A. funiculosus, H. sativum after I and II spray; C. flavum, Sclerotium rolfsii, after II and III spray; C. magnum after III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of C. echinulata, Mucor mucedo, A. fumigatus, A. flavus, A. niger, A. sydowi, T. viride, F. udum, D. australiensis, A. alternata, Hormiscium stilbosporum and yellow sterile mycelium decreased after each spray; A. ustus after I spray; C. bertholletiae, A. funiculosus, A. terricola, F. oxysporum, H. sativum after I and II spray; C. flavum after II and III spray; C. magnum, Rhizoctonia solani after III spray. Same pattern was noticed in other forms also. Higher Frequency value in the rhizosphere of inoculated plants after 100 ppm of maleic hydrazide was noticed for F. udum, whereas lower frequency value for a number of fungi such as-R. oryzae, C. echinulata, Mortierella alpina, Aspergillus flavus, A. funiculosus, A. niger, A. ustus, C. flavum, M. olivaceum, F. oxysporum, D. australiensis, A. alternata, H. sativum, R. solani, S. rolfsii and yellow sterile mycelium. In the cultivar BDN-1, higher frequency value was recorded for Aspergillus niger, whereas lower frequency value for a number of fungi viz. Rhizopus nigricans, C. echinulata, Mucor mucedo, A. flavus, A. funiculosus, A. ustus, A. terricola, C. flavum, M. olivaceum, T. viride, F. udum, F. oxysporum, D. australiensis, A. alternata, H. sativum, R. solani, S. rolfsii and yellow sterile mycelium.

A perusal of table 20 indicates that the frequency of most of the fungi in the rhizoplane of uninoculated plants of both the cultivars decreased with the application of 100 ppm of maleic hydrazide after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Trichoderma viride, Pullularia pullulans and black sterile mycelium decreased after each spray; C. roseo-griseum, T. album after I and II spray; Curvularia pallescens after II and III spray; A. nidulans, Drechslera australiensis, Helminthosporium sativum after III spray. Rest of the fungi exhibited a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, R. nigricans, A. fumigatus, A. flavus, A. niger, A. candidus, C. curtipes, T. viride, P. pullulans and black sterile mycelium decreased after each spray; Cunninghamella bertholletiae, Syncephalastrum racemosum, D. australiensis after I and II spray; C. pallescens, D. hawaiiensis, H. sativum after III spray. Rest of the forms followed a similar pattern. Higher frequency value in the rhizoplane of uninoculated plants of cultivar T-21 after 100 ppm of maleic hydrazide spray was recorded for A. fumigatus; and lower frequency value for most of the fungi i.e. R. oryzae, C. tenella, A. funiculosus, A. sulphureus, A. candidus, C. curtipes, T. viride, T. album, D. australiensis, H. sativum and black sterile mycelium. In the cultivar BDN-1, higher frequency value was recorded for A. fumigatus, A. niger and C. curtipes; and lower for R. oryzae, R. nigricans, C. bertholletiae, S. racemosum, A. flavus, A. funiculosus, A. terreus, A. candidus, C. roseo-griseum, T. viride, T. album, C. pallescens,

D. australiensis, D. hawaiiensis, H. sativum and P. pullulans (Table 20). In the rhizoplane of inoculated plants with the application of 100 ppm of maleic hydrazide, the frequency of almost all the fungi in both the cultivars T-21 and BDN-1 decreased. In the cultivar T-21, the frequency of R. oryzae, Mucor globosus, A. fumigatus, A. flavus, A. funiculosus, A. niger, Fusarium udum and D. australiensis decreased after each spray; Cunninghamella echinulata after I spray; A. nidulans after II spray; Rhizoctonia solani, Sclerotium rolfsii after II and III spray; H. sativum after III spray. Similar trend was shown by other fungi. In the cultivar BDN-1, the frequency of Rhizopus nigricans, Mucor mucedo, A. fumigatus, A. flavus A. niger, C. curtipes, T. viride, P. pullulans and yellow sterile mycelium decreased after each spray; Trichoderma album after I and II spray; A. funiculosus, C. pallescens, D. australiensis, D. hawaiiensis, R. solani, S. rolfsii after II and III spray; H. sativum after III spray. Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21 after 100 ppm of maleic hydrazide spray was recorded for A. fumigatus, F. udum and lower frequency for R. oryzae, C. echinulata, M. globosus, A. funiculosus, A. niger, A. luchuensis, A. nidulans, A. candidus, C. pallescens, D. australiensis, D. hawaiiensis, P. pullulans, R. solani,

S. rolfsii and yellow sterile mycelium. In the cultivar BDN-1, higher frequency value was recorded for Aspergillus niger; and lower for R. nigricans, C. echinulata, C. bertholletiae, M. mucedo, A. flavus, A. terreus, A. candidus, T. viride, T. album, F. udum, C. pallescens D. australiensis, D. hawaiiensis, H. sativum, P. pullulans, R. solani, S. rolfsii and yellow sterile mycelium (Table 20).

It is clear from the above results that foliar sprays of indole acetic acid, indole butyric acid, thio-indole butyric acid and gibberellic acid showed stimulatory effect on the population of rhizosphere fungi of uninoculated and inoculated plants of both the cultivars T-21 and BDN-1; however, maleic hydrazide showed inhibitory effect. Effect of foliar spray of different chemicals was significant at 5% and 1% level. Higher fungal population was recorded in the rhizosphere of inoculated plants of both the cultivars in comparison to uninoculated counterparts in all the treatments. In the rhizosphere and rhizoplane of uninoculated plants of both the cultivars T-21 and BDN-1, the frequency of majority of the fungi increased with the spray of indole acetic acid, indole butyric acid, thio-indole butyric acid and gibberellic acid and decreased with maleic hydrazide spray. In the rhizosphere and rhizoplane of inoculated plants of both the cultivars, the frequency of most of the fungi increased with spray of indole acetic acid, indole butyric acid, thio-indole butyric acid and gibberellic acid, however, the frequency of some of the saprophytic forms decreased with indole acetic acid (in the rhizosphere and rhizoplane of both the cultivars), indole butyric acid (in the rhizosphere of T-21) and thio-indole butyric acid (in the rhizoplane of both the cultivars). On the other hand, the frequency of majority of fungi decreased with maleic hydrazide spray in the rhizosphere and rhizoplane of both the cultivars. The frequency of Fusarium udum increased in the rhizosphere and rhizoplane of both the cultivars with indole acetic acid, indole butyric acid, thio-indole butyric acid and gibberellic acid spray; however, decreased with maleic hydrazide spray. In the rhizosphere and rhizoplane of uninoculated plants of both the cultivars the frequency of majority of saprophytic forms was found higher than the parasitic forms in all the treatments. On the other hand, in the inoculated plants the frequency of parasitic forms was found higher in comparison to saprophytic forms in the rhizosphere and rhizoplane of cultivar T-21 and rhizoplane of BDN-1 in all the treatment except with maleic hydrazide (in the rhizosphere of T-21 and in the rhizoplane of BDN-1). However, in the rhizosphere of BDN-1, a reverse trend was observed except indole butyric acid treatment.

FIG. 3. Population of fungi in the rhizosphere of uninoculated and inoculated plants of pigeon pea cultivar T-21 (with *Fusarium udum* Butler) treated with different foliar sprays.

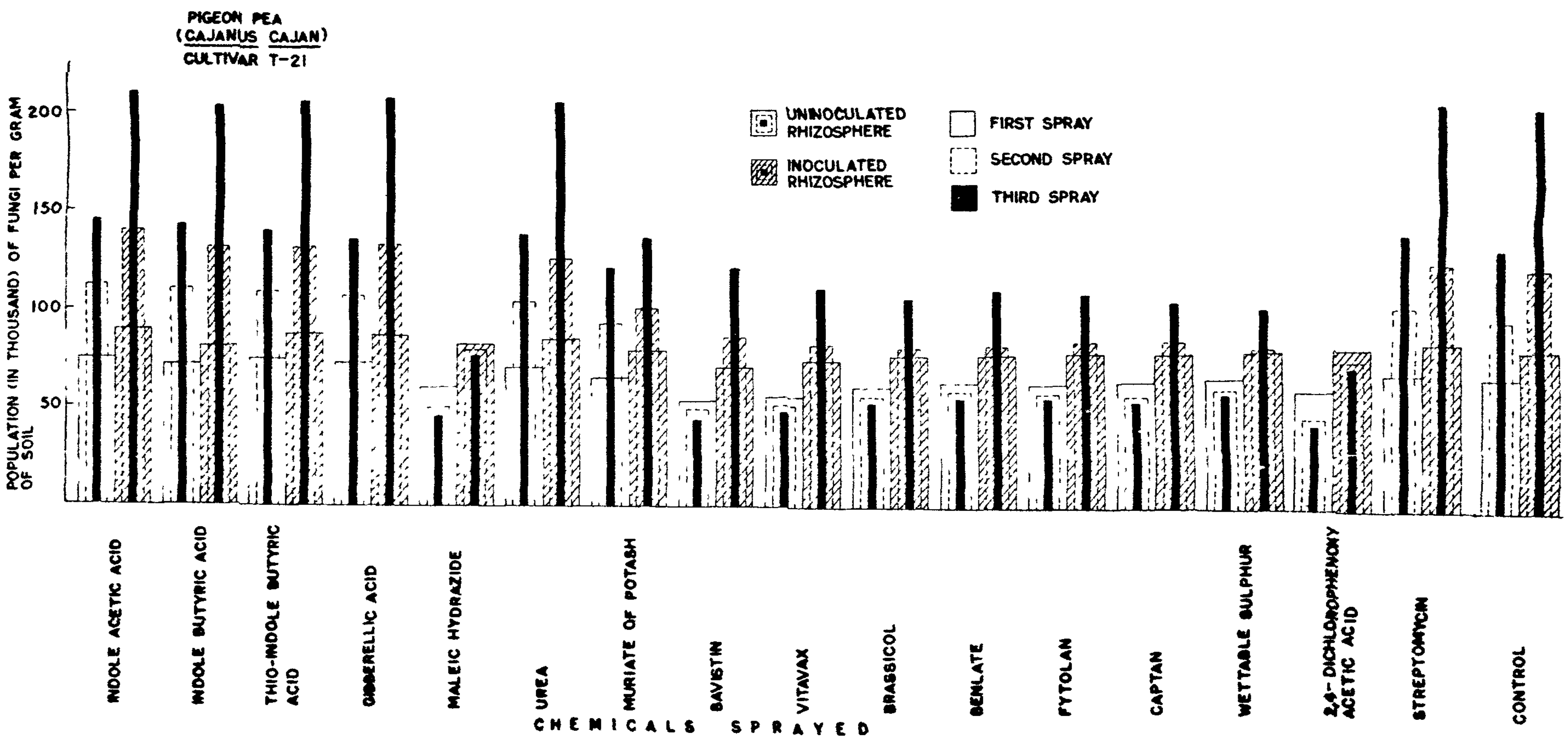

PIGEON PEA
(CAJANUS CAJAN)
CULTIVAR T-21
POPULATION (IN THOUSAND) OF FUNGI PER GRAM OF SOIL
200
150
100
50
UNINOCULATED RHIZOSPHERE
INOCULATED RHIZOSPHERE
FIRST SPRAY
SECOND SPRAY
THIRD SPRAY
INDOLE ACETIC ACID
INDOLE BUTYRIC ACID
THIO-INDOLE BUTYRIC ACID
GIBBERELLIC ACID
MALEIC HYDRAZIDE
UREA
MURIATE OF POTASH
BAVISTIN
VITAVAX
BRASSICOL
BENLATE
FYTOLAN
CAPTAN
WETTABLE SULPHUR
2,4-DICHLOROPHENOXY ACETIC ACID
STREPTOMYCIN
CONTROL
CHEMICALS SPRAYED
FIG. 3

FIG. 4. Population of fungi in the rhizosphere of uninoculated and inoculated plants of pigeon pea cultivar BDN-1 (with *Fusarium udum* Butler) treated with different foliar sprays.

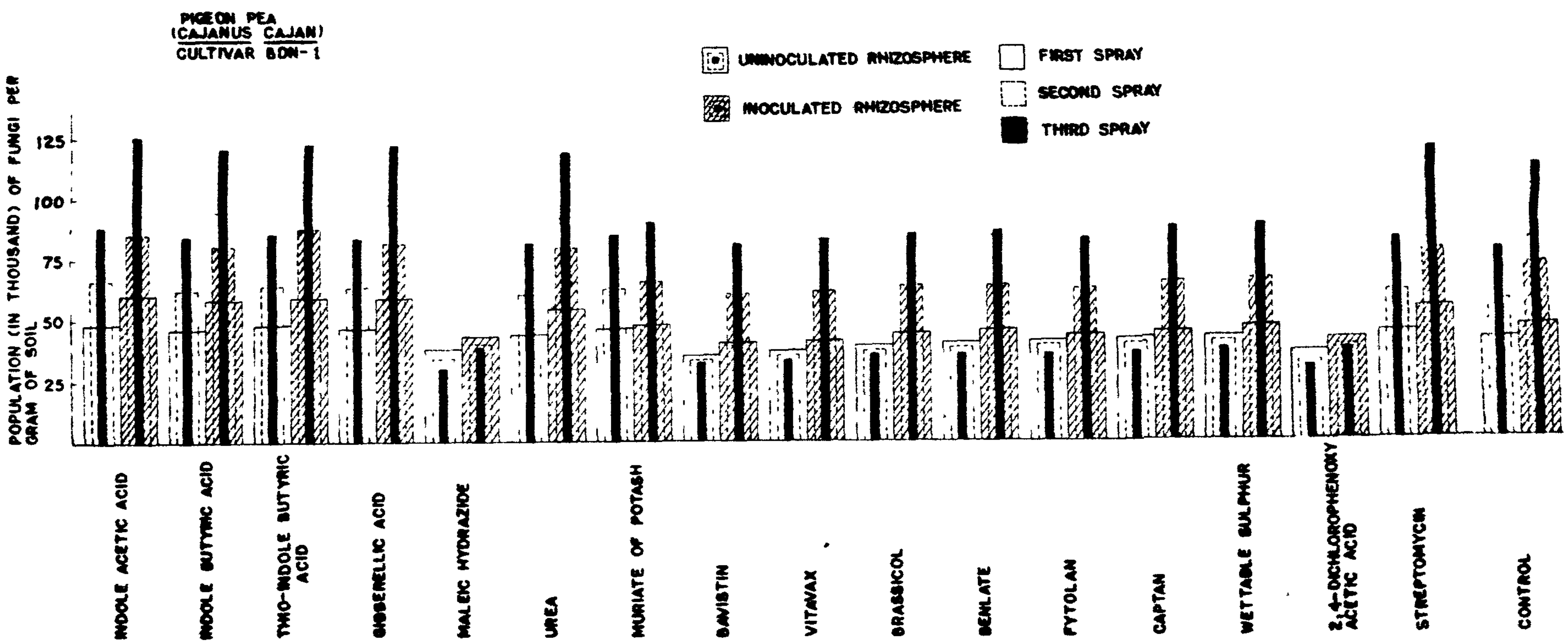

PIGEON PEA
(CAJANUS CAJAN)
CULTIVAR BDN-1
UNINOCULATED RHIZOSPHERE
INOCULATED RHIZOSPHERE
FIRST SPRAY
SECOND SPRAY
THIRD SPRAY
POPULATION (IN THOUSAND) OF FUNGI PER GRAM OF SOIL
125
100
75
50
25
INDOLE ACETIC ACID
INDOLE BUTYRIC ACID
THIO-INDOLE BUTYRIC ACID
GIBBERELLIC ACID
MALEIC HYDRAZIDE
UREA
MURIATE OF POTASH
BAVISTIN
VITAVAX
BRASSICOL
BENLATE
FYTOLAN
CAPTAN
WETTABLE SULPHUR
2,4-DICHLOROPHENOXY ACETIC ACID
STREPTOMYCIN
CONTROL
CHEMICALS SPRAYED

FIG. 4

TABLE 10. Effect of foliar spray of different chemicals on population of fungi (per gram of soil) in the non-rhizosphere and rhizosphere of pigeon pea(cultivars T-21 and BDN-1) uninoculated and inoculated with *F. udum*.

Treatments	T - 21						BDN - 1					
	Uninoculated plants			Inoculated plants			Uninoculated plants			Inoculated plants		
	I spray	II spray	III spray	I spray	II spray	III spray	I spray	II spray	III spray	I spray	II spray	III spray
Non-rhizosphere	9.5*	11.5	12	9.5	11.5	12	9.5	11.5	12	9.5	11.5	12
Control	66	95	130	80	120.2	200.6	40	55	76	45	70	110
Indole acetic acid	76	112	145	90	140	210	48	66	88	60	85	125
Indole butyric acid	73	110	142	86	130	202.8	46	62	84	58	80	120
Thio-indole butyric acid	74	109	140	87	132	205	47.5	63.9	84.9	59	82	121.9
Gibberellic acid	73.5	107	139	86.7	131.8	206	46.2	63	83	58.5	81	121
Maleic hydrazide	60	50	46	82	79	76	38	34	30	43	40	38.5
Urea	70	103	137	84	125	203	44	60	81	54	79	118
Potash	65	92	120	78	100	135	46	62	84	47	65	90
Bavistin	53	49.5	44	70	85	120	35	33	32	40	60	80
Vitavax	55	51	48	74	82	110	36.8	35	33	41	61	82
Brassicol	60.3	56.5	52	76	80	185	39	37	35.1	44	62.8	84
Benlate	62.8	58.9	55	76.5	81	108	40.2	38	36.3	45	63	85
Fytolan	62	57	55	77	82	107	40.5	39	35	43	61.9	81.2
Captan	63	56	53	76.9	83	103	41.3	39.4	35.8	43.8	63.8	85.9
Wettable sulphur	64.5	59.8	57	79	80	100	42	40	37	46.8	65	87
2,4-dichlorophenoxy acetic acid	58	45	42	80	74	71	36	31.5	29.8	41	38	37
Streptomycin	69.5	101	136	82	122	201.75	43.3	59.2	80.3	53	76	117
L.S.D. at 5%	0.74144	0.88205	0.87590	0.61278	1.36923	1.10011	0.47209	0.73596	0.67668	0.34181	0.83241	1.02511
L.S.D. at 1%	0.99696	1.18602	1.17776	0.82396	1.84109	1.47923	0.63478	0.98959	0.90987	0.45961	1.11928	1.37839

*in thousand.

TABLE 19. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with maleic hydrazide.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	20	15	10	20	15	10	15	10	5	20	20	30	20	15	10	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	10	10	5	10	10	5	-	-
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	25	25	15	-	-	-	-	-	-	25	20	10	20	15	10
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	10	10	5	20	10	5	15	5	-
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	10	5	5
Mucor racemosus Fresenius	-	-	-	-	-	-	10	15	20	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	15	10	5	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	20	15	10	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	50	40	30	60	50	40	50	40	30	50	55	60	45	40	35	55	50	45	50	45	40
A. flavus Link	40	50	60	35	30	30	40	35	30	30	20	20	45	50	60	40	40	35	30	30	25	30	25	20
A. funiculosus G. Smith	10	10	10	5	-	-	20	10	-	10	5	-	15	20	20	10	5	-	10	5	-	5	5	-
A. niger van Tieghem	20	25	30	15	10	10	30	25	20	25	20	20	70	80	85	65	50	40	45	40	30	40	35	25
A. luchuensis Inui	10	15	10	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	10	5	-	30	30	30	25	20	20	30	40	45	30	25	20	15	10	5	10	5	5
A. nidulans (Eidam) Winter	30	30	35	25	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	20	20	25	15	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	-	5	20	10	5	15	10	5	25	30	35	20	20	15	20	15	15	15	10	5
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	25	20	15	20	25	25	15	15	10	10	5	5	5	-	-
A. terricola Marchal	30	35	40	25	20	15	-	-	-	-	-	-	30	40	50	25	20	20	15	10	5	10	5	-
A. sydowi (Bainier & Sartory) Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	25	20	15	25	20	15	20	15	10
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	25	20	15	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	20	15	15	-	-	-	-	-	-	50	55	60	45	40	30	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	10	10	5	-	-	-	-	-	-	20	25	30	15	10	10	-	-	-	-	-	-
C. asperum Marchal	10	10	10	5	5	-	-	-	-	-	-	-	-	-	10	-	-	5	-	-	-	-	-	-
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	10	5	5	-	-	-	-	-	-	10	15	20	10	5	5
Trichoderma viride Pers. ex Fr.	30	30	35	20	20	15	-	-	-	-	-	-	25	30	35	20	15	15	10	15	20	10	10	5
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	-	-	5	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	60	55	50	-	-	-	-	-	-	10	25	30	10	10	10
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	10	10	5	-	-	-	-	-	-	10	15	20	10	5	-
Fusidium viride Grove	-	-	10	-	-	5	-	-	-	-	-	-	-	-	15	-	-	10	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	5	5	-	20	30	40	15	15	10	10	10	10	10	5	5	20	30	40	20	15	10
Curvularia pallescens Boedijn	10	10	10	5	5	5	10	10	10	5	5	5	15	10	15	10	5	10	25	30	35	20	10	5
Alternaria alternata (Fr.) Keissler	-	-	-	-	-	-	10	10	10	5	5	5	10	10	10	10	5	-	15	20	25	15	10	5
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	10	5	-	-	-	-	-	-	-	10	10	15	5	5	-
Hormiscium stilbosporum (Corda) Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	10	5	5
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	5	5	-	-	-	-	-	-	-	5	10	-	-	5
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	5	5	-	-	-	-	-	-	-	5	10	-	-	10
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	10	5	5	-	-	-	-	-	-	10	10	10	10	5	5
Black sterile mycelium	10	15	20	10	5	5	-	-	-	-	-	-	20	25	30	20	15	15	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 18. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with gibberellic acid.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	20	30	35	20	15	10	25	25	30	10	15	30	15	30	40	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	25	30	40	15	10	10	20	15	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	15	20	20	-	-	-	-	-	-	20	15	10	30	20	20
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	25	10	10	5	15	10	-
Circinella tenella (Ling-Young) Zycha	20	25	30	30	35	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	15	30	35	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	20	30	35
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	20	35	40	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	70	80	90	60	55	50	70	60	55	50	60	60	60	70	85	50	45	40	55	40	35
A. flavus Link	40	45	50	50	60	65	45	40	35	60	55	50	35	40	45	40	50	55	30	30	25	50	40	40
A. funiculosus G. Smith	20	25	30	25	30	35	30	-	-	40	-	-	15	20	20	20	25	30	25	15	-	35	20	-
A. niger van Tieghem	15	15	15	20	25	30	15	10	5	30	25	20	80	85	100	90	100	100	60	55	40	70	60	50
A. luchuensis Inui	10	10	15	15	20	25	15	-	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	5	5	10	-	-	-	-	-	-	20	35	40	25	40	45	15	10	5	20	20	15
A. nidulans (Eidam) Winter	-	5	10	-	15	20	-	10	5	25	20	10	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	15	20	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	15	20	15	10	5	25	20	15	30	35	40	35	40	45	20	15	15	30	20	20
Cephalosporium curtipes Saccardo	25	25	30	30	35	40	-	-	-	-	-	-	55	60	70	60	70	80	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	15	20	25	-	-	-	-	-	-	25	30	40	30	35	45	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	30	30	35	-	-	-	-	-	-	30	35	40	30	35	45	20	15	10	30	20	15
T. album Preuss	10	10	10	15	20	25	-	-	-	-	-	-	10	15	20	15	20	25	10	10	5	20	20	20
Fusarium udum Butler	-	-	-	-	-	-	70	80	85	80	85	90	-	-	-	-	-	-	20	30	40	25	35	45
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	-	-	15	15	20	20	20	25	-	15	20	-	30	40	-	30	35	-	40	45
D. hawaiiensis Subram. & Jain ex M.B. Ellis	-	-	5	-	-	20	5	10	15	20	30	40	-	-	15	-	-	20	-	10	20	-	20	30
Curvularia pallescens Boedijn	-	10	15	-	15	30	-	20	25	-	25	35	-	5	10	-	10	15	-	10	30	-	15	35
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	25	-	-	35	-	20	45	-	-	10	-	-	20	-	5	25	5	10	30
Pullularia pullulans (de Bary) Berkhout	15	20	25	20	30	40	20	25	30	30	40	50	10	15	20	15	20	30	15	30	40	20	35	45
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	20	25	-	-	-	-	-	-	-	10	20	-	20	25
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	20	25	-	-	-	-	-	-	-	10	30	-	15	35
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	30	40	45	-	-	-	-	-	-	15	20	25	-	25	30
Black sterile mycelium	30	35	35	35	40	50	-	-	-	-	-	-	40	45	50	50	55	60	-	-	-	-	-	-

*Number of spray.
UCP = Uninoculated control plants.
UP = Uninoculated plants.

**Calculated on the basis of 20 replicates.
ICP = Inoculated control plants.
IP = Inoculated plants.

TABLE 17. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivar T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with gibberellic acid.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	30	35	35	20	15	10	25	20	20	20	20	30	40	45	50	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	20	-	-	-	15	10	5	20	25	30	25	30	35	5	10	10	20	15	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	40	30	25	-	-	-	-	-	-	25	20	10	-	-	-
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	20	30	35	20	10	5	30	15	10
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	15	20	20	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	15	20	30
M. racemosus Fresenius	-	--	-	-	-	-	10	15	20	-	20	25	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	25	30	40	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	15	30	40	-	-	-	-	-	-	-	-	-	-	-	-	-	--	-	-	-	-
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	30	40	50	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	70	75	85	60	50	40	65	60	60	50	55	60	60	70	85	55	50	45	65	60	50
A. flavus Link	40	50	60	50	60	70	40	35	30	45	40	35	45	50	60	50	60	70	30	30	25	40	35	35
A. funiculosus G. Smith	10	10	10	15	20	20	20	10	-	25	15	-	15	20	20	20	25	25	10	5	-	20	10	5
A. niger van Tieghem	20	25	30	25	30	35	30	25	20	35	20	20	70	80	85	80	95	100	45	40	30	50	45	30
A. luchuensis Inui	10	15	10	15	25	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	15	20	25	30	30	30	35	35	35	30	40	45	40	40	50	15	10	5	20	15	15
A. nidulans (Eidam) Winter	30	30	35	40	45	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	20	20	25	35	35	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	--
A. candidus Link	-	5	10	5	10	20	20	10	5	25	15	10	25	30	35	30	35	40	20	15	15	25	10	15
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	35	25	25	20	25	25	25	30	35	10	5	5	15	10	10
A. terricola Marchal	30	35	40	35	40	45	35	30	15	40	35	20	30	40	50	35	45	55	15	10	5	20	20	15
A. sydowi (Bainier & Sartory) Thom &	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	40	45	50	25	20	15	30	25	20
C. magnum Bainier	-	-	15	-	15	35	-	-	25	-	20	50	-	-	5	-	15	25	-	-	25	-	15	35
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	20	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	-	40	45	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	35	40	45	-	-	-	-	-	-	50	55	60	60	70	75	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	25	30	40	-	-	-	-	-	-	20	25	30	30	35	40	-	-	-	-	-	-
C. aspermum Marchal	10	10	10	15	20	20	-	-	-	-	-	-	-	-	10	-	-	20	-	-	10	-	-	30
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	15	20	30	-	-	-	-	-	-	10	15	20	15	20	30
Trichoderma viride Pers. ex Fr.	30	30	35	40	50	60	-	-	-	-	-	-	25	30	35	30	35	40	10	15	20	15	30	35
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	10	15	20	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	70	75	80	-	-	-	-	-	-	15	25	30	20	25	35
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	20	30	40	-	-	-	-	-	-	10	15	20	15	20	25
Fusidium viride Grove	-	-	10	-	-	20	-	-	-	-	-	-	-	-	15	-	-	30	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	15	20	25	20	30	40	25	35	45	10	10	10	15	15	20	20	30	40	25	30	45
Curvularia pallescens Boedijn	10	10	10	15	10	30	10	10	10	20	25	30	15	10	15	20	25	25	25	30	35	30	35	35
Alternaria alternata (Fr.) Keissler	-	-	-	-	-	-	10	10	10	15	20	25	10	10	10	25	30	30	15	20	25	20	25	30
Helminthosporium sativum Pammel, King, & Bakke	-	-	-	-	-	-	10	15	20	15	30	40	-	-	-	-	-	-	10	10	15	15	20	25
Hormiscium stilbosporum (Corda) Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	20	25	30
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	10	20	-	-	-	-	-	-	-	5	10	-	15	20
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	10	15	-	-	-	-	-	-	-	5	10	-	15	25
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	15	20	25	-	-	-	-	-	-	10	10	10	15	20	20
Black sterile mycelium	10	15	20	25	30	35	-	-	-	-	-	-	20	25	30	40	50	55	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants

ICP = Inoculated control plants

IP = Inoculated plants.

TABLE 16. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN - 1), uninoculated and inoculated with F. udum, sprayed with thio-indole butyric acid.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
<u>Rhizopus</u> <u>oryzae</u> Went & Gerlings	15**	25	30	20	30	35	20	15	10	20	25	25	10	15	30	15	20	35	-	-	-	-	-	-
<u>R.</u> <u>nigricans</u> Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	30	35	40	15	10	10	20	15	15
<u>Cunninghamella</u> <u>echinulata</u> Thaxter	-	-	-	-	-	-	10	10	10	15	20	25	-	-	-	-	-	-	20	15	15	25	10	10
<u>C.</u> <u>bertholletiae</u> Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	20	35	40	10	10	5	15	15	10
<u>Circinella</u> <u>tenella</u> (Ling-Young) Zycha	20	25	30	30	35	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Mucor</u> <u>globosus</u> Fischer	-	-	-	-	-	-	10	15	30	15	20	35	-	-	-	-	-	-	-	-	-	-	-	-
<u>M.</u> <u>mucedo</u> (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	30
<u>Syncephalastrum</u> <u>racemosum</u>(Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	20	35	40	-	-	-	-	-	-
<u>Aspergillus</u> <u>fumigatus</u> Fresenius	60	60	60	65	70	75	60	55	50	65	60	60	50	60	60	60	75	85	50	45	40	60	50	40
<u>A.</u> <u>flavus</u> Link	40	45	50	50	55	60	45	40	35	50	45	40	35	40	45	40	45	50	30	30	25	35	30	30
<u>A.</u> <u>funiculosus</u> G. Smith	20	25	30	25	30	40	30	-	-	40	-	-	15	20	20	20	35	40	25	15	-	35	30	-
<u>A.</u> <u>niger</u> van Tieghem	15	15	15	20	25	30	15	10	5	20	15	10	80	85	100	90	95	100	60	55	40	65	50	40
<u>A.</u> <u>luchuensis</u> Inui	10	10	15	15	20	25	15	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>A.</u> <u>terreus</u> Thom	-	-	5	-	-	15	-	-	-	-	-	-	20	35	40	30	40	50	15	10	5	20	15	10
<u>A.</u> <u>nidulans</u> (Eidam) Winter	-	5	10	-	10	20	-	10	5	-	15	10	-	-	-	-	-	-	-	-	-	-	-	-
<u>A.</u> <u>sulphureus</u> (Fresenius) Thom & Church	10	10	20	15	20	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>A.</u> <u>candidus</u> Link	-	10	15	-	15	25	15	10	5	20	15	10	30	35	40	35	40	45	20	15	15	25	20	20
<u>Cephalosporium</u> <u>curtipes</u> Saccardo	25	25	30	30	40	45	-	-	-	-	-	-	55	60	70	60	70	80	-	-	-	-	-	-
<u>C.</u> <u>roseo-griseum</u> Saksena	10	15	20	15	20	30	-	-	-	-	-	-	25	30	40	30	40	45	-	-	-	-	-	-
<u>Trichoderma</u> <u>viride</u> Pers. ex Fr.	20	25	25	30	35	40	-	-	-	-	-	-	30	35	40	35	40	45	20	15	10	20	20	20
<u>T.</u> <u>album</u> Preuss	10	10	10	15	20	25	-	-	-	-	-	-	10	15	20	15	20	25	10	10	5	15	15	10
<u>Fusarium</u> <u>udum</u> Butler	-	-	-	-	-	-	70	80	85	85	95	100	-	-	-	-	-	-	20	30	40	25	35	45
<u>Curvularia</u> <u>pallescens</u> Boedijn	-	10	15	-	15	20	-	20	25	-	25	30	-	5	10	-	15	20	-	10	30	-	20	40
<u>Drechslera</u> <u>australiensis</u> Subram.& Jain ex M.B. Ellis	-	-	10	-	-	20	15	15	20	20	20	25	-	15	20	-	20	30	-	30	35	-	35	40
<u>D.</u> <u>hawaiiensis</u> Subram.& Jain ex M.B.Ellis	-	-	5	-	-	15	-	10	15	10	15	20	-	-	15	-	-	25	-	10	20	-	20	45
<u>Helminthosporium</u> <u>sativum</u> Pammel, King & Bakke	-	-	20	-	-	30	-	-	35	-	-	45	-	-	10	-	-	15	-	5	25	-	10	30
<u>Pullularia</u> <u>pullulans</u> (de Bary)Berkhout	15	20	25	20	30	40	20	25	30	40	45	50	10	15	20	15	20	30	15	30	40	20	35	45
<u>Rhizoctonia</u> <u>solani</u> Kuhn	-	-	-	-	-	-	-	10	20	-	20	30	-	-	-	-	-	-	-	10	20	-	15	25
<u>Sclerotium</u> <u>rolfsii</u> Saccardo	-	-	-	-	-	-	-	15	20	-	20	25	-	-	-	-	-	-	-	10	30	-	15	30
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	30	40	50	-	-	-	-	-	-	15	20	35	20	30	40
Black sterile mycelium	30	35	35	40	45	50	-	-	-	-	-	-	40	45	50	50	55	60	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants

ICP = Inoculated control plants.

UP = Uninoculated plants.

IP = Inoculated plants.

TABLE 15. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with F. udum, sprayed with thio-indole butyric acid.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	30	35	35	20	15	10	25	25	25	20	20	30	25	30	40	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	10	15	-	-	-	-	-	-	20	25	30	30	35	40	5	10	10	10	15	20
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	35	35	40	-	-	-	-	-	-	25	20	10	25	25	20
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	15	20	30	20	10	5	25	15	10
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	10	15	20	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	15	15	20
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	15	20	25	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	25	30	35	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	20	25	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	30	40	45	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	70	75	80	60	50	40	65	55	45	50	55	60	60	70	85	55	50	45	60	55	50
A. flavus Link	45	50	60	55	60	65	40	35	30	50	40	35	45	50	60	50	65	70	30	30	25	35	40	30
A. funiculosus G. Smith	10	10	10	15	20	25	20	10	-	25	20	10	15	20	20	20	35	40	10	5	-	15	10	5
A. niger van Tieghem	20	25	30	25	30	35	30	25	20	25	25	25	70	80	85	80	85	95	45	40	30	50	50	45
A. luchuensis Inui	10	15	10	15	25	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	15	25	30	30	30	30	35	40	35	30	40	45	35	45	50	15	10	5	20	15	10
A. nidulans (Eidam) Winter	30	30	35	35	40	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	20	20	25	25	25	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	10	20	20	10	5	25	20	10	25	30	35	30	40	50	20	15	15	35	25	20
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	35	30	30	20	25	25	25	35	45	10	5	5	15	10	10
A. terricola Marchal	30	35	40	35	40	45	35	30	15	35	35	30	30	40	50	40	50	55	15	10	5	25	20	10
A. sydowi (Bainier & Sartory) Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	40	45	50	25	20	15	30	25	20
Chaetomium flavum Omvik	-	10	10	-	15	20	-	15	30	-	20	35	-	5	10	-	15	20	-	10	20	-	15	25
C. magnum Bainier	-	-	15	-	-	20	-	-	25	-	-	50	-	-	5	-	-	10	-	-	25	-	-	30
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	35	40	45	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	35	40	45	-	-	-	-	-	-	50	55	60	55	60	70	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	20	30	35	-	-	-	-	-	-	20	25	30	30	35	45	-	-	-	-	-	-
C. asperum Marchal	10	10	10	15	20	30	-	-	-	-	-	-	-	-	10	5	10	20	-	-	10	-	-	15
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	15	20	25	-	-	-	-	-	-	10	15	20	15	20	25
Trichoderma viride Pers. ex Fr.	30	30	35	35	40	45	-	-	-	-	-	-	25	30	35	30	45	50	10	15	20	15	20	30
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	10	15	20	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	70	85	90	-	-	-	-	-	-	15	25	30	20	30	35
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	15	20	30	-	-	-	-	-	-	10	15	20	15	20	25
Fusidium viride Grove	-	-	10	-	-	20	-	-	-	-	-	-	-	-	15	-	-	30	-	-	-	-	-	-
Drechslera australiensis Subram.& Jain ex M.B. Ellis	10	15	15	15	20	20	20	30	40	30	40	50	10	10	10	15	20	20	20	30	40	25	35	45
Curvularia pallescens Boedijn	10	10	10	15	20	25	10	10	10	15	20	25	15	10	15	25	20	20	25	30	35	30	35	45
Alternaria alternata (Fr.) Keissler	-	-	-	-	-	-	10	10	10	15	20	30	10	10	10	15	20	25	15	20	25	20	25	30
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	15	20	30	-	-	-	-	-	-	10	10	15	15	15	20
Hormiscium stilbosporum (Corda) Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	15	25	30
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	15	25	-	-	-	-	-	-	-	5	10	-	10	15
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	15	25	-	-	-	-	-	-	-	5	10	-	10	20
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	20	30	40	-	-	-	-	-	-	10	10	10	20	25	30
Black sterile mycelium	10	15	20	20	25	30	-	-	-	-	-	-	20	25	30	35	40	45	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 16. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN - 1), uninoculated and inoculated with F. udum, sprayed with thio-indole butyric acid.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	20	30	35	20	15	10	20	25	25	10	15	30	15	20	35	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	30	35	40	15	10	10	20	15	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	15	20	25	-	-	-	-	-	-	20	15	15	25	10	10
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	20	35	40	10	10	5	15	15	10
Circinella tenella (Ling-Young) Zycha	20	25	30	30	35	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	15	20	35	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	30
Syncephalastrum racemosum(Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	20	35	40	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	65	70	75	60	55	50	65	60	60	50	60	60	60	75	85	50	45	40	60	50	40
A. flavus Link	40	45	50	50	55	60	45	40	35	50	45	40	35	40	45	40	45	50	30	30	25	35	30	30
A. funiculosus G. Smith	20	25	30	25	30	40	30	-	-	40	-	-	15	20	20	20	35	40	25	15	-	35	30	-
A. niger van Tieghem	15	15	15	20	25	30	15	10	5	20	15	10	80	85	100	90	95	100	60	55	40	65	50	40
A. luchuensis Inui	10	10	15	15	20	25	15	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	-	-	15	-	-	-	-	-	-	20	35	40	30	40	50	15	10	5	20	15	10
A. nidulans (Eidam) Winter	-	5	10	-	10	20	-	10	5	-	15	10	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	15	20	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	15	25	15	10	5	20	15	10	30	35	40	35	40	45	20	15	15	25	20	20
Cephalosporium curtipes Saccardo	25	25	30	30	40	45	-	-	-	-	-	-	55	60	70	60	70	80	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	15	20	30	-	-	-	-	-	-	25	30	40	30	40	45	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	30	35	40	-	-	-	-	-	-	30	35	40	35	40	45	20	15	10	20	20	20
T. album Preuss	10	10	10	15	20	25	-	-	-	-	-	-	10	15	20	15	20	25	10	10	5	15	15	10
Fusarium udum Butler	-	-	-	-	-	-	70	80	85	85	95	100	-	-	-	-	-	-	20	30	40	25	35	45
Curvularia pallescens Boedijn	-	10	15	-	15	20	-	20	25	-	25	30	-	5	10	-	15	20	-	10	30	-	20	40
Drechslera australiensis Subram.& Jain ex M.B. Ellis	-	-	10	-	-	20	15	15	20	20	20	25	-	15	20	-	20	30	-	30	35	-	35	40
D. hawaiiensis Subram.& Jain ex M.B.Ellis	-	-	5	-	-	15	-	10	15	10	15	20	-	-	15	-	-	25	-	10	20	-	20	45
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	30	-	-	35	-	-	45	-	-	10	-	-	15	-	5	25	-	10	30
Pullularia pullulans (de Bary)Berkhout	15	20	25	20	30	40	20	25	30	40	45	50	10	15	20	15	20	30	15	30	40	20	35	45
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	20	30	-	-	-	-	-	-	-	10	20	-	15	25
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	20	25	-	-	-	-	-	-	-	10	30	-	15	30
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	30	40	50	-	-	-	-	-	-	15	20	35	20	30	40
Black sterile mycelium	30	35	35	40	45	50	-	-	-	-	-	-	40	45	50	50	55	60	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 13. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with indole butyric acid.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	30	35	40	20	15	10	20	25	25	20	20	30	30	35	40	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	25	30	35	5	10	10	15	20	20
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	35	40	40	-	-	-	-	-	-	25	20	10	30	35	40
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	15	20	25	20	10	5	20	20	25
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	15	15	15	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	15	20	25
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	15	20	30	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	25	30	35	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	20	25	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	30	35	35	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	60	70	80	60	50	40	65	60	50	50	55	60	60	70	75	55	50	45	60	55	40
A. flavus Link	45	50	60	50	55	65	40	35	30	45	40	40	45	50	60	50	60	70	30	30	25	35	35	30
A. funiculosus G. Smith	10	10	10	15	20	20	20	10	-	25	20	-	15	20	20	20	25	30	10	5	-	15	10	-
A. niger van Tieghem	20	25	30	25	30	35	30	25	20	25	20	25	70	80	85	80	90	100	45	40	30	50	45	35
A. luchuensis Inui	10	15	10	15	25	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	15	20	25	30	30	30	35	30	35	30	40	45	35	45	50	15	10	5	20	15	15
A. nidulans (Eidam) Winter	30	30	35	30	35	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	20	20	25	25	30	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	15	20	20	10	5	25	15	10	25	30	35	30	40	40	20	15	15	30	25	25
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	35	20	10	20	25	25	25	30	35	10	5	5	15	10	5
A. terricola Marchal	30	35	40	35	40	45	35	30	15	40	35	20	30	40	50	35	45	55	15	10	5	20	15	10
A. sydowi (Bainier & Sartory)	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	40	45	50	25	20	15	25	25	20
Chaetomium flavum Omvik	-	10	10	-	15	20	-	15	30	-	20	35	-	5	10	-	15	20	-	10	20	-	20	40
C. magnum Bainier	-	-	15	-	-	20	-	-	25	-	-	40	-	-	5	-	-	15	-	-	25	-	-	35
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	35	40	50	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	35	40	45	-	-	-	-	-	-	50	55	60	60	70	75	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	20	30	35	-	-	-	-	-	-	20	25	30	35	40	40	-	-	-	-	-	-
C. asperum Marchal	10	10	10	20	25	25	-	-	-	-	-	-	-	-	10	-	-	20	-	-	10	-	-	20
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	15	20	25	-	-	-	-	-	-	10	15	20	20	30	35
Trichoderma viride Pers. ex Fr.	30	30	35	35	40	40	-	-	-	-	-	-	25	30	35	30	35	40	10	15	20	20	35	40
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	10	15	20	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	70	85	90	-	-	-	-	-	-	15	25	30	25	30	35
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	15	20	35	-	-	-	-	-	-	10	15	20	15	20	25
Fusidium viride Grove	-	-	10	-	-	20	-	-	-	-	-	-	-	-	15	-	-	30	-	-	-	-	-	-
Drechslera australiensis Subram.& Jain ex M.B. Ellis	10	15	15	15	20	25	20	30	40	30	35	45	10	10	10	15	15	20	20	30	40	30	35	45
Curvularia pallescens Boedijn	10	10	10	15	20	20	10	10	10	15	20	35	15	10	15	20	25	30	25	30	35	30	40	50
Alternaria alternata (Fr.)Keissler	-	-	-	-	-	-	10	10	10	15	20	40	10	10	10	15	20	25	15	20	25	20	25	40
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	20	30	45	-	-	-	-	-	-	10	10	15	15	15	20
Hormiscium stilbosporum (Corda) Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	20	25	30
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	10	20	-	-	-	-	-	-	-	5	10	-	10	15
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	15	30	-	-	-	-	-	-	-	5	10	-	10	20
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	20	25	30	-	-	-	-	-	-	10	10	10	20	25	35
Black sterile mycelium	10	15	20	20	30	40	-	-	-	-	-	-	20	25	30	40	45	60	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 12. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with indole acetic acid.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	20	30	35	20	15	10	20	25	25	10	15	30	20	30	40	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	25	30	35	15	10	10	20	25	25
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	15	20	20	-	-	-	-	-	-	20	15	15	25	30	30
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	25	10	10	5	15	20	20
Circinella tenella (Ling-Young) Zycha	20	25	30	30	35	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	15	20	35	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	30
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	20	30	40	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	70	75	80	60	55	50	55	50	40	50	60	60	60	65	70	50	45	40	45	40	35
A. flavus Link	40	45	50	50	55	60	45	40	35	40	35	30	35	40	45	40	45	55	30	30	25	30	25	20
A. funiculosus G. Smith	20	25	30	25	30	35	30	-	-	15	10	-	15	20	20	20	30	30	25	15	-	25	20	10
A. niger van Tieghem	15	15	15	20	25	25	15	10	5	15	10	10	80	85	100	90	100	100	60	55	40	60	50	35
A. luchuensis Inui	10	10	15	15	20	25	15	-	-	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	5	10	15	-	-	-	-	-	-	20	35	40	30	40	45	15	10	5	10	5	5
A. nidulans (Eidam) Winter	-	5	10	-	10	15	-	10	5	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	15	20	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	15	25	15	10	5	10	5	5	30	35	40	35	40	45	20	15	15	15	10	10
Cephalosporium curtipes Saccardo	25	25	30	30	35	40	-	-	-	-	-	-	55	60	70	60	70	75	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	15	20	30	-	-	-	-	-	-	25	30	40	30	45	50	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	25	30	35	-	-	-	-	-	-	30	35	40	35	40	45	20	15	10	15	10	10
T. album Preuss	10	10	10	15	20	20	-	-	-	-	-	-	10	15	20	20	25	25	10	10	5	10	5	5
Fusarium udum Butler	-	-	-	-	-	-	70	80	85	90	100	100	-	-	-	-	-	-	20	30	40	30	40	45
Curvularia pallescens Boedijn	-	10	15	-	15	25	-	20	25	-	30	40	-	5	10	-	10	20	-	10	30	-	15	35
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	-	15	15	15	20	20	25	35	-	15	20	-	20	25	-	30	35	-	40	50
D. hawaiiensis Subram.& Jain ex M.B.Ellis	-	-	5	-	5	15	5	10	15	10	20	35	-	-	15	-	10	30	-	10	20	-	20	30
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	35	-	-	35	-	-	50	-	-	10	-	-	20	-	5	25	-	10	30
Pullularia pullulans (de Bary) Berkhout	15	20	25	20	25	35	20	25	30	25	30	40	10	15	20	15	20	25	15	30	40	20	35	40
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	15	25	-	-	-	-	-	-	-	10	20	-	15	25
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	25	30	-	-	-	-	-	-	-	10	30	-	20	35
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	30	35	45	-	-	-	-	-	-	15	20	25	20	30	35
Black sterile mycelium	30	35	35	35	40	45	-	-	-	-	-	-	40	45	50	50	55	60	-	-	-	-	-	-

*Number of spray.

** Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants
UP = Uninoculated plants.

ICP = Inoculated control plants.
IP = Inoculated plants.

TABLE 11. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inculated with *F. udum*, sprayed with indole acetic acid.

Fungi isolated	T- 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	35	40	45	20	15	10	25	25	30	20	20	30	30	35	40	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	35	25	30	45	15	10	10	20	25	30
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	30	35	35	-	-	-	-	-	-	25	20	10	30	30	35
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	15	20	25	20	10	5	30	35	40
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	15	15	20	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	20	25	30
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	20	25	35	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	25	30	35	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	20	30	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	30	40	50	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	65	70	75	60	50	40	65	60	50	50	55	60	55	65	70	55	50	45	60	55	55
A. flavus Link	45	50	60	50	60	65	40	35	30	45	40	40	45	50	60	50	60	70	30	30	25	35	35	30
A. funiculosus G. Smith	10	10	10	25	25	30	20	10	-	20	15	5	15	20	20	20	30	30	10	5	-	15	10	-
A. niger van Tieghem	20	25	30	25	30	40	30	25	20	30	30	25	70	80	85	80	95	100	45	40	30	50	45	45
A. luchuensis Inui	10	15	10	15	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	20	15	20	30	30	30	30	30	35	40	30	40	45	40	45	50	15	10	5	20	15	10
A. nidulans (Eidam) Winter	30	30	35	35	40	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius)Thom & Church	20	20	25	25	30	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	15	20	20	10	5	25	15	15	25	30	35	30	40	45	20	15	15	15	10	10
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	25	20	20	20	25	25	25	30	30	10	5	5	5	5	-
A. terricola Marchal	30	35	40	40	45	45	35	30	15	20	15	10	30	40	50	40	45	55	15	10	5	10	10	-
A. sydowi (Bainier & Sartory) Thom &	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	40	50	60	25	20	15	20	15	10
Chaetomium flavum Omvik	-	10	10	-	15	20	-	15	30	-	30	40	-	5	10	-	10	20	-	10	20	-	20	25
C. magnum Bainier	-	-	15	-	-	30	-	-	25	-	15	35	-	-	5	-	5	15	-	-	25	-	-	30
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	10	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	40	45	45	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	35	40	45	-	-	-	-	-	-	50	55	60	60	65	70	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	20	30	35	-	-	-	-	-	-	20	25	30	25	30	30	-	-	-	-	-	-
C. asperum Marchal	10	10	10	20	25	25	-	-	-	-	-	-	-	-	10	-	-	30	-	-	10	-	-	30
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	15	20	20	-	-	-	-	-	-	10	15	20	20	25	25
Trichoderma viride Pers. ex Fr.	30	30	35	40	45	50	-	-	-	-	-	-	20	30	35	30	40	45	10	15	20	15	20	20
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	10	15	15	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	80	90	100	-	-	-	-	-	-	15	25	30	30	40	45
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	20	30	40	-	-	-	-	-	-	10	15	20	15	20	25
Fusidium viride Grove	-	-	10	5	5	15	-	-	-	-	-	-	-	-	15	-	-	20	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	15	20	25	20	30	40	30	35	45	10	10	10	15	20	20	20	30	40	25	35	45
Curvularia pallescens Boedijn	10	10	10	15	20	20	10	10	10	20	25	30	15	10	15	15	20	25	25	30	35	30	35	40
Alternaria alternata (Fr.) Keissler	-	-	-	-	-	-	10	10	10	20	25	30	10	10	10	15	20	25	15	20	25	20	25	30
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	25	30	40	-	-	-	-	-	-	10	10	15	15	20	20
Hormiscium stilbosporum (Corda) Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	20	25	30
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	10	15	-	-	-	-	-	-	-	5	10	-	15	15
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	10	20	-	-	-	-	-	-	-	5	10	-	15	20
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	15	20	25	-	-	-	-	-	-	10	10	10	20	25	30
Black sterile mycelium	10	15	20	20	25	30	-	-	-	-	-	-	20	25	35	25	35	45	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 20. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with F. udum, sprayed with maleic hydrazide.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	15	10	10	20	15	10	15	15	10	10	15	30	10	10	5	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	10	10	15	10	10	10	5	5
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	5	-	-	-	-	-	-	-	-	20	15	15	15	10	10
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	5	5	-	10	10	5	5	5	5
Circinella tenella (Ling-Young) Zycha	20	25	30	15	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	10	5	5
Syncephalastrum racemosum (Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	10	5	-	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	50	45	45	60	55	50	55	50	40	50	60	60	45	40	40	50	45	40	45	40	35
A. flavus Link	40	45	50	35	30	25	45	40	35	40	35	35	35	40	45	30	25	20	30	30	25	25	25	20
A. funiculosus G. Smith	20	25	30	15	15	10	30	-	-	25	20	10	15	20	20	15	10	10	25	15	-	20	10	-
A. niger van Tieghem	15	15	15	10	5	5	15	10	5	15	10	10	80	85	100	75	70	60	60	55	40	55	50	40
A. luchuensis Inui	10	10	15	10	5	5	15	-	-	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	-	-	-	-	-	-	-	-	-	20	35	40	15	10	5	15	10	5	10	10	5
A. nidulans (Eidam) Winter	-	5	10	-	-	5	-	10	5	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	5	-	15	10	5	10	5	5	30	35	40	25	25	20	20	15	15	15	10	5
Cephalosporium curtipes Saccardo	25	25	30	20	15	10	-	-	-	-	-	-	55	60	70	50	45	40	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	5	5	-	-	-	-	-	-	-	25	30	40	20	15	10	-	-	-	-	-	-
Trichoderma viride Pers. ex. Fr.	20	25	25	15	15	10	-	-	-	-	-	-	30	35	40	25	20	15	20	15	10	15	10	10
T. album Preuss	10	10	10	10	5	-	-	-	-	-	-	-	10	15	20	10	5	5	10	10	5	5	5	-
Fusarium udum Butler	-	-	-	-	-	-	70	80	85	65	60	55	-	-	-	-	-	-	20	30	40	15	10	5
Curvularia pallescens Boedijn	-	10	15	-	10	5	-	20	25	-	15	10	-	5	10	-	-	5	-	10	30	-	10	5
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	-	5	15	15	20	15	10	10	-	15	20	-	10	10	-	30	35	-	25	20
D. hawaiiensis Subram.& Jain ex M.B. Ellis	-	-	5	-	-	-	5	10	15	5	5	-	-	-	15	-	-	10	-	10	20	-	10	10
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	15	-	-	35	-	-	30	-	-	10	-	-	5	-	5	25	-	-	20
Pullularia pullulans (de Bary) Berkhout	15	20	25	10	10	5	20	25	30	15	15	10	10	15	20	5	5	5	15	30	40	10	10	5
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	5	10	-	-	-	-	-	-	-	10	20	-	10	10
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	10	5	-	-	-	-	-	-	-	10	30	-	10	5
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	15	15	10	-	-	-	-	-	-	15	20	35	10	10	5
Black sterile mycelium	30	35	35	20	20	15	-	-	-	-	-	-	40	45	50	35	30	30	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.
UP = Uninoculated plants.

ICP = Inoculated control plants.
IP = Inoculated plants.

(b) Fertilizers:

A perusal of tables 21 and 23 indicates that number of fungal species isolated from the rhizosphere of pigeon pea sprayed with 100 ppm of urea after I, II and III spray was 18, 20, 23 in uninoculated plants and 21, 24, 24 in inoculated counterparts of cultivar T-21, 22, 23, 26 in uninoculated and 23, 26, 27 in inoculated plants of cultivar BDN-1; with 100 ppm of muriate of potash after I, II and III spray 17, 21, 20 in uninoculated and 21, 24, 23 in inoculated plants of T-21, 19, 18, 19 in uninoculated and 23, 22, 20 in inoculated plants of BDN-1 for the corresponding periods as against 18, 20, 23 in uninoculated and 21, 24, 24 in inoculated control plants of T-21 22, 23, 26 in uninoculated and 23, 26, 26 in inoculated control plants of BDN-1.

From tables 22 and 24, it is evident that number of fungal species isolated from the rhizoplane treated with 100 ppm of urea after I, II and III spray was 14, 17, 21 in uninoculated plants and 14, 16, 17 in inoculated counterparts of cultivar T-21, 16, 18, 20 in uninoculated and 15, 21, 20 in inoculated plants of cultivar BDN-1; with 100 ppm of muriate of potash after I, II and III spray; 14, 16, 18 in uninoculated and 13, 16, 16 in inoculated plants of T-21, 16, 17, 20 in uninoculated and 15, 20, 19 in inoculated plants of BDN-1 for the corresponding periods as against 14, 17, 21 in uninoculated and 14, 16, 17 in inoculated control plants of T-21, 16, 18, 20 in-inoculated and 15, 21, 20 in inoculated control plants of cultivar BDN-1.

It is evident from fig. 3 & 4 and table 10 that population of fungi in the rhizosphere of plants sprayed with 100 ppm urea after I, II and III spray was 70000, 103000, 137000 in uninoculated plants and 84000, 125000, 203000 in inoculated counterparts of cultivar T-21, 44000, 60000, 81000 in uninoculated and 54000, 79000, 118000 in inoculated plants of cultivar BDN-1; with 100 ppm of muriate of potash after I, II and III spray 65000, 92000, 120000 in uninoculated and 78000, 100000, 135000 in inoculated plants of T-21, 46000, 62000, 84000 in uninoculated and 47000, 65000, 90000 in inoculated plants of BDN-1 for the corresponding periods as against 66000, 95000, 130000 in uninoculated and 80000, 120200, 200600 in inoculated control plants of T-21, 40000, 55000, 76000 in uninoculated and 45000, 70000, 110000 in inoculated control plants of BDN-1. However, the population of fungi in the non-rhizosphere soil for the corresponding period was 9500, 11500, 12000 respectively.

A perusal of table 21 shows that the frequency of most of the fungi in the rhizosphere of uninoculated plants of both the cultivars T-21 and BDN-1 increased with the application of 100 ppm of urea after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, A. luchuensis, *A. sulphureus*, *Cephalosporium curtipes*, *Trichoderma viride*, *Drechslera australiensis*, *Curvularia pallescens* and black sterile mycelium increased after each spray; *A. candidus*, *Chaetomium flavum* after II and III spray; *C. magnum*, *Gelasinospora cerealis*, *Fusidium viride* after III spray. Rest of the forms followed the same pattern. In the cultivar BDN-1, the frequency of *R. oryzae*, *R. nigricans*, *Syncephalastrum racemosum*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terricola*, *C. curtipes*, *T. viride*, *D. australiensis*, *C. pallescens*, *Alternaria alternata* and black sterile mycelium increased after each spray; *C. flavum* after II and III spray; *C. magnum*, *Cephalosporium aspermum*, *F. viride* after III spray. Similar pattern was shown by rest of the fungi. Higher frequency value in the rhizosphere of uninoculated plants of cultivar T-21 after 100 ppm of urea spray was recorded for *A. fumigatus*, *A. flavus*, *A. niger*, *A. nidulans*, *A. terricola*, *C. curtipes*, *C. roseo-griseum*, *T. viride* and black sterile mycelium; and lower for *A. funiculosus*, *A. luchuensis*, *C. flavum*, *C. magnum*, *C. aspermum*, *G. cerealis* and *C. pallescens*. In the cultivar BDN-1, higher frequency value was shown by *Rhizopus nigricans*, *S. racemosum*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terreus*, *A. candidus*, *A. ustus*, *A. terricola*, *A. sydowi*, *Penicillium chrysogenum*, *C. curtipes*, *T. viride* and black sterile mycelium; and lower for *C. flavum*, *C. magnum*,

C. aspermum, T. lignorum (Table 21). In the rhizosphere of inoculated plants of cultivars T-21 and BDN-1 with the application of 100 ppm of urea after I, II and III spray, the frequency of majority of the fungi increased after each spray. In the cultivar T-21, the frequency of R. oryzae, Cunninghamella echinulata, A. fumigatus, A. flavus, A. niger, Monosporium olivaceum, Fusarium udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, Helminthosporium sativum and yellow sterile mycelium increased after each spray; A. funiculosus after I and II spray; C. flavum, Rhizoctonia solani, Sclerotium rolfsii after II and III spray; C. magnum after III spray. Rest of the fungi followed the similar pattern. In cultivar BDN-1, the frequency of R. nigricans, Cunninghamella bertholletiae, Mucor mucedo, A. fumigatus, A. flavus, A. niger, A. sydowi, T. viride, F. udum, F. oxysporum D. australiensis, A. alternata, H. sativum and yellow sterile mycelium increased after each spray; A. funiculosus after I and II spray; C. flavum, R. solani, S. rolfsii after II and III spray; C. magnum, Cephalosporium aspermum after III spray. Same pattern was shown by rest of the fungi. Higher frequency value in the rhizosphere of inoculated plants of cultivar T-21 after 100 ppm of urea spray was exhibited by A. fumigatus, C. flavum, C. magnum, F. udum, D. australiensis, and lower by A. candidus, M. olivaceum, C. pallescens, R. solani and

and *S. rolfsii*. In the cultivar BDN-1, higher frequency value was recorded for *A. fumigatus*, *F. udum*, *D. australiensis*, and *C. pallescens*; and lower frequency value for *R. nigricans*, *A. funiculosus*, *A. terreus*, *A. sulphureus*, *A. candidus*, *A. terricola*, *A. sydowi*, *C. aspermum*, *R. solani* and *S. rolfsii* (Table 21).

It is evident from Table 22 that the frequency of majority of the fungi increased with the application of 100 ppm of urea after I, II and III spray, in the rhizoplane of uninoculated plants of both the cultivars T-21 and BDN-1. In the cultivar T-21, the frequency of *Rhizopus oryzae*, *Circinella tenella*, *Aspergillus fumigatus*, *A. flavus*, *A. luchuensis*, *A. sulphureus*, *Cephalosporium curtipes*, *Trichoderma viride*, *Pullularia pullulans* and black sterile mycelium increased after each spray; *A. nidulans*, *A. candidus*, *Curvularia pallescens* after II and III spray; *A. terreus*, *Drechslera australiensis*, *D. hawaiiensis* after III spray. A similar trend was shown by other fungi. In the cultivar BDN-1, the frequency of *R. oryzae*, *Syncephalastrum racemosum*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. candidus*, *C. curtipes*, *T. viride*, *T. album*, *P. pullulans* and black sterile mycelium increased after each spray; *C. pallescens*, *D. australiensis* after II and III spray; *D. hawaiiensis* and *Helminthosporium sativum* after III spray. Other fungi followed a similar pattern.

Higher frequency value in the rhizosphere of uninoculated plants of cultivar T-21, after 100 ppm of urea spray, was noticed for C. tenella, A. fumigatus, A. flavus, A. funiculosus, C. curtipes, P. pullulans and black sterile mycelium; and lower frequency value for A. terreus, A. nidulans, Trichoderma album, C. pallescens, D. australiensis and D. hawaiiensis. In the cultivar BDN-1, higher frequency value was recorded for R. oryzae, R. nigricans, A. fumigatus, A. flavus, A. funiculosus, A. niger, A. terreus, A. candidus, C. curtipes, C. roseo-griseum, T. viride and black sterile mycelium; and lower frequency for C. pallescens and Drechslera hawaiiensis (Table 22). In the rhizoplane of inoculated plants of cultivars T-21 and BDN-1, with the application of 100 ppm of urea, the frequency of most of the fungi increased after I, II and III spray. In the cultivar T-21, the frequency of R. oryzae, Mucor globosus, A. fumigatus, A. flavus, A. niger, Fusarium udum, D. australiensis and yellow sterile mycelium increased after each spray; A. funiculosus, L. lucknensis after I spray; A. nidulans, C. pallescens, Rhizoctonia solani and Sclerotium rolfsii after II and III spray; H. sativum after III spray. Rest of the fungi followed the similar trend. In the cultivar BDN-1, the frequency of Rhizopus nigricans, Cunninghamella echinulata, A. fumigatus, A. flavus, A. niger, A. candidus, T. viride, F. udum and yellow sterile mycelium increased after each spray; A. funiculosus after I and II spray;

C. pallescens, D. australiensis, D. hawaiiensis, H. sativum, R. solani and S. rolfsii after II and III spray. Similar pattern was shown by majority of the fungi. Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21 after 100 ppm of urea spray was noticed for A. fumigatus, A. funiculosus, A. flavus, F. udum, C. pallescens, H. sativum, P. pullulans and yellow sterile mycelium; and lower for R. oryzae, C. echinulata, A. niger, A. luchuensis, A. nidulans, and A. candidus. In the cultivar BDN-1, higher frequency value was recorded for A. fumigatus, A. flavus, A. niger, F. udum, D. australiensis, P. pullulans and yellow sterile mycelium; and lower frequency value for R. nigricans, C. echinulata, C. bertholletiae, A. terreus, A. candidus, T. viride and T. album (Table 22).

A perusal of table 23 shows that in the rhizosphere of uninoculated plants of cultivar T-21, with the application of 100 ppm of potash after I, II and III spray, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. funiculosus, A. niger, A. luchuensis, A. terreus, A. nidulans, A. sulphureus, A. terricola, Cephalosporium curtipes, C. roseo-griseum, C. aspermum, Trichoderma viride and black sterile mycelium increased after each spray; A. candidus, Gelasinospora cerealis after II and III spray; Fusidium viride after III spray. On the other hand, the frequency of *Curvularia pallescens* after I and II spray; *Chaetomium flavum* after II spray; *Drechslera australiensis* after II and III spray decreased. In the cultivar BDN-1, the frequency of *R. oryzae*, *R. nigricans*, *Cunninghamella echinulata*, *Syncephalastrum racemosum*, *A. fumigatus*, *A. flavus*, *A. funiculosus*, *A. niger*, *A. terreus*, *A. candidus*, *A. ustus*, *A. terricola*, *A. sydowi*, *Penicillium chrysogenum*, *C. curtipes*, *C. roseo-griseum*, *T. viride*, *T. lignorum* and black sterile mycelium increased after each spray; *C. aspermum* and *F. viride* after III spray. On the other hand, the frequency of *D. australiensis* after I spray; *C. pallescens*, *Alternaria alternata* after I and II spray; *C. flavum* after III spray decreased. Higher frequency value in the rhizosphere of uninoculated plants of cultivar T-21 after 100 ppm of potash spray was noticed for *R. oryzae*, *C. tenella*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. nidulans*, *A. terricola*, *C. curtipes*, *C. roseo-griseum*, *T. viride* and black sterile mycelium; and lower frequency for *C. flavum*, *Cephalosporium aspermum*, *G. cerealis*, *D. australiensis* and *C. pallescens*. In the cultivar BDN-1, higher frequency value was recorded for *R. oryzae*, *S. racemosum*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terreus*, *A. candidus*, *A. ustus*, *A. terricola*, *A. sydowi*, *C. curtipes*, *C. roseo-griseum*, *T. viride* and black sterile mycelium; and lower for *C. flavum*, *T. lignorum* *D. australiensis*, *C. pallescens* and *A. alternata* (Table 23). In the rhizosphere of inoculated plants of cultivar T-21, with the application of 100 ppm of potash after I, II and III spray, the frequency of R. oryzae, C. echinulata, Mucor globosus, Mucor racemosus, Mortierella alpina, A. fumigatus, A. flavus, A. funiculosus, A. niger, A. terreus, A. candidus, A. ustus, A. terricola, Monosporium olivaceum increased after each spray. On the other hand, the frequency of Fusarium udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, Helminthosporium sativum and yellow sterile mycelium decreased after each spray; C. flavum after II and III spray; C. magnum after III spray. In the cultivar BDN-1, the frequency of Rhizopus nigricans, C. echinulata, C. bartholletiae, Mucor mucedo, A. fumigatus, A. flavus, A. funiculosus, A. niger, A. terreus, A. candidus, A. ustus, A. terricola, A. sydowi, M. olivaceum and T. viride, increased after each spray; Cephalosporium aspermum after II and III spray. On the other hand, the frequency of D. australiensis, C. pallescens decreased after each spray; F. udum, H. sativum, after I spray; F. oxysporum, A. alternata, Hormiscium stilbosporum after I and II spray; C. flavum after II spray; C. magnum, Rhizoctonia solani after III spray. Higher frequency value in the rhizosphere of inoculated plants of T-21 after 100 ppm of potash spray was exhibited by R. oryzae, C. echinulata, A. fumigatus, A. flavus, A. niger, A. terreus, A. ustus and A. terricola; and lower by C. flavum, C. magnum, M. olivaceum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, H. sativum,

R. solani, Sclerotium rolfsii and yellow sterile mycelium. In the cultivar BDN-1, higher frequency value was recorded for A. fumigatus, A. flavus, A. niger, A. terreus, A. terricola, A. sydowi; and lower for C. flavum, C. magnum, Cephalosporium aspermum, F. udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, H. sativum, H. stilbosporium, R. solani and yellow sterile mycelium (Table 23).

It is clear from table 24 that in the rhizoplane of uninoculated plants of cultivar T-21, with the application of 100 ppm of potash after I, II and III spray, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. funiculosus, A. niger, A. luchuensis, A. sulphureus, A. candidus, Cephalosporium curtipes, C. roseo-griseum, Trichoderma viride increased after each spray; T. album after I and II spray; A. candidus after II and III spray; A. nidulans after III spray. On the other hand, the frequency of Pullularia pullulans and black sterile mycelium decreased after each spray; Curvularia pallescens after II and III spray; Drechslera australiensis and Helminthosporium sativum after III spray. In the cultivar BDN-1, the frequency of R. oryzae, R. nigricans, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. funiculosus, A. niger, A. terreus, A. candidus, C. curtipes, C. roseo-griseum, T. viride and T. album increased after each spray. On the other hand, the frequency of P. pullulans and yellow sterile mycelium decreased after each spray; D. australiensis after II and III spray; C. pallescens, D. hawaiiensis, H. sativum after III spray. Higher frequency value in the rhizoplane of uninoculated plants of cultivar T-21 after 100 ppm of potash spray was recorded for R. oryzae, C. tenella, A. fumigatus, A. flavus, C. curtipes, and T. viride ; and lower for A. luchuensis, A. nidulans, A. candidus, C. pallescens, D. australiensis, H. sativum and P. pullulans. In the cultivar BDN-1, higher frequency value was noticed for Rhizopus nigricans, S. racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, A. candidus, C. curtipes, C. roseo-griseum, and T. viride; and lower for C. pallescens, D. australiensis, D. hawaiiensis, H. sativum and P. pullulans (Table 24). In the rhizoplane of inoculated plants of cultivar T-21, with the application of 100 ppm of potash after I, II and III spray, the frequency of R. oryzae, Cunninghamella echinulata, Mucor globosus, A. fumigatus, A. flavus, A. niger, A. candidus increased after each spray; A. luchuensis after I spray; A. nidulans after II spray. On the other hand, the frequency of Fusarium udum, D. australiensis, P. pullulans and yellow sterile mycelium decreased after each spray; C. pallescens, D. hawaiiensis, Rhizoctonia solani and Sclerotium rolfsii after II and III spray; H. sativum after III spray. In the cultivar BDN-1, the frequency of Rhizopus nigricans, C. echinulata, C. bertholletiae, Mucor mucedo, A. fumigatus, A. flavus, A. niger, A. terreus, A. candidus,

T. viride and T. album increased after each spray; A. funiculosus after I and II spray. On the other hand, the frequency of P. pullulans and yellow sterile mycelium decreased after each spray; F. udum after I spray; C. pallescens, D. australiensis, D. hawaiiensis, H. sativum, R. solani and S. rolfsii after II and III (Table 24). Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21 after 100 ppm of potash spray was shown by R. oryzae, A. fumigatus and A. flavus; and lower by C. echinulata, A. nidulans, A. candidus, C. pallescens, D. australiensis, R. solani and S. rolfsii. In the cultivar BDN-1, higher frequency value was noticed for A. fumigatus, A. flavus and A. niger; and lower for F. udum, C. pallescens, D. hawaiiensis, H. sativum, P. pullulans, R. solani and S. rolfsii.

It is evident from the above results that by and large foliar spray with urea showed stimulatory effect on the population of fungi in the rhizosphere of uninoculated and inoculated plants of both the cultivars T-21 and BDN-1. On the other hand, potash spray showed inhibitory effect in the rhizosphere of uninoculated and inoculated plants of cultivar T-21 and only inoculated plants of cultivar BDN-1 except after I spray, however, a stimulatory effect was shown in the rhizosphere of uninoculated plants of cultivar BDN-1. Effect of foliar spray was significant at 5% and 1% level. The frequency of majority of the fungi increased in the rhizosphere and rhizoplane of uninoculated and inoculated plants of both the cultivars with urea spray. On the other hand, with potash spray, the frequency of most of the saprophytic fungi increased and majority of parasitic forms decreased in the rhizosphere and rhizoplane of uninoculated and inoculated plants of both the cultivars T-21 and BDN-1. The frequency of Fusarium udum increased with urea spray and decreased with potash spray. In the rhizosphere and rhizoplane of uninoculated plants of both the cultivars, the frequency of most of the saprophytic forms was higher in comparison to the parasitic forms with urea and potash spray and only with potasy spray in inoculated plants. However, a reverse trend was observed with urea in the rhizosphere and rhizoplane of inoculated plants.

TABLE 23. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with potash.

Fungi isolated	T- 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizomus oryzae Went & Gerlings	25**	30	30	30	35	40	20	15	10	25	30	40	20	20	30	25	35	40	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	25	30	35	5	10	10	20	30	35
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	30	35	40	-	-	-	-	-	-	25	20	10	20	30	35
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	10	20	25	20	10	5	25	30	35
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	10	15	20	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	20	20	25
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	15	25	30	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	25	30	35	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zucha	10	20	30	15	30	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	35	40	45	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	65	75	80	60	50	40	65	70	75	50	55	60	60	70	80	55	50	45	60	70	75
A. flavus Link	40	50	60	55	60	65	40	35	30	50	55	60	45	50	60	55	60	75	30	30	25	45	60	70
A. funiculosus G. Smith	10	10	10	15	20	25	20	10	-	25	30	35	15	20	20	20	25	30	10	5	-	15	20	25
A. niger van Tieghem	20	25	30	25	35	45	30	25	20	35	40	45	70	80	85	80	95	100	45	40	30	55	60	70
A. luchuensis Inui	10	15	10	15	20	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	15	25	30	30	30	30	30	35	40	20	40	45	40	45	50	15	10	5	25	35	40
A. nidulans (Eidam) Winter	30	30	35	35	40	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	20	20	25	25	30	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	15	30	20	10	5	25	30	35	25	30	35	30	40	45	20	15	15	25	30	35
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	30	35	40	20	25	25	30	35	40	10	5	5	20	25	30
A. terricola Marchal	30	35	40	35	40	45	35	30	15	30	35	40	30	40	50	40	50	60	15	10	5	25	30	45
A. sydowi (Bainier & Sartory) Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	40	45	50	25	20	15	30	35	40
Chaetomium flavum Omvik	-	10	10	-	5	-	-	15	30	-	10	5	-	5	10	-	-	5	-	10	20	-	5	-
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	10	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	40	45	50	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	40	45	55	-	-	-	-	-	-	50	55	60	55	60	65	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	25	35	45	-	-	-	-	-	-	20	25	30	55	60	65	-	-	-	-	-	-
C. asperum Marchal	10	10	10	10	15	15	-	-	-	-	-	-	-	-	10	-	-	30	-	-	10	-	10	20
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	5	10	15	-	-	-	-	-	-	10	15	20	15	20	25
Trichoderma viride Pers.ex Fr.	30	30	35	35	40	45	-	-	-	-	-	-	25	30	35	30	35	40	10	15	20	20	25	35
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	10	15	20	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	45	35	25	-	-	-	-	-	-	15	25	30	5	-	-
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	15	10	5	-	-	-	-	-	-	10	15	20	10	5	-
Fusidium viride Grove	-	-	10	-	-	35	-	-	-	-	-	-	-	-	15	-	-	35	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	-	10	5	20	30	40	15	10	5	10	10	10	5	-	-	20	30	40	15	10	5
Curvularia pallescens Boedijn	10	10	10	5	5	-	10	10	10	15	10	5	15	10	15	10	5	-	25	30	35	20	10	5
Alternaria alternata (Fr) Keissler	-	-	-	-	-	-	10	10	10	10	10	5	10	10	10	5	5	-	15	20	25	10	5	-
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	10	10	5	-	-	-	-	-	-	10	10	15	5	-	-
Hormiscium stilbosporum (Corda)Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	10	5	-
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	5	-	-	-	-	-	-	-	-	5	10	-	-	5
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	5	-	-	-	-	-	-	-	-	5	10	-	-	-
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	15	10	5	-	-	-	-	-	-	10	10	10	5	-	-
Black sterile mycelium	10	15	20	20	30	40	-	-	-	-	-	-	20	25	30	30	35	45	-	-	-	-	-	-

*Number of spray

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 22. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with urea.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	25	30	35	20	15	10	25	20	20	10	15	30	20	30	45	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	35	40	50	15	10	10	25	20	20
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	15	15	15	-	-	-	-	-	-	20	15	15	30	20	20
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	25	10	10	5	20	20	15
Circinella tenella (Ling-Young) Zycha	20	25	30	30	45	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	15	20	35	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	30
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	20	25	35	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	65	70	75	60	55	50	65	60	60	50	60	60	60	65	70	50	45	40	60	55	50
A. flavus Link	40	45	50	45	50	60	45	40	35	50	45	40	35	40	45	40	45	55	30	30	25	50	45	40
A. funiculosus G. Smith	20	25	30	25	35	40	30	-	-	40	-	-	15	20	20	20	30	40	25	15	-	35	30	-
A. niger van Tieghem	15	15	15	30	35	35	15	10	5	20	15	10	80	85	100	90	95	95	60	55	40	70	60	50
A. luchuensis Inui	10	10	15	20	25	30	15	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	-	-	15	-	-	-	-	-	-	20	35	40	30	40	45	15	10	5	20	15	10
A. nidulans (Eidam) Winter	-	5	10	-	10	20	-	10	5	-	15	10	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	15	20	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	20	35	15	10	5	20	15	10	30	35	40	35	40	45	20	15	15	30	20	20
Cephalosporium curtipes Saccardo	25	25	30	35	40	50	-	-	-	-	-	-	55	60	70	60	65	75	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	15	20	30	-	-	-	-	-	-	25	30	40	30	40	50	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	25	30	35	-	-	-	-	-	-	30	35	40	35	45	50	20	15	10	30	20	15
T. album Preuss	10	10	10	15	20	20	-	-	-	-	-	-	10	15	20	15	20	25	10	10	5	15	10	10
Fusarium udum Butler	-	-	-	-	-	-	70	80	85	75	85	90	-	-	-	-	-	-	20	30	40	25	35	45
Curvularia pallescens Boedijn	-	10	15	-	15	20	-	20	25	-	30	40	-	5	10	-	15	20	-	10	30	-	20	35
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	-	20	15	15	20	20	25	30	-	15	20	-	20	30	-	30	35	-	40	45
D. hawaiiensis Subram.& Jain ex M.B.Ellis	-	-	5	-	-	15	5	10	15	15	20	35	-	-	15	-	-	20	-	10	20	-	15	25
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	30	-	-	35	-	-	40	-	-	10	-	-	30	-	5	25	-	15	30
Pullularia pullulans (de Bary) Berkhout	15	20	25	20	35	40	20	25	30	25	35	40	10	15	20	15	20	30	15	30	40	20	35	45
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	20	25	-	-	-	-	-	-	-	10	20	-	20	25
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	25	30	-	-	-	-	-	-	-	10	30	-	15	35
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	30	40	50	-	-	-	-	-	-	15	20	35	20	25	40
Black sterile mycelium	30	35	35	35	40	50	-	-	-	-	-	-	40	45	50	50	55	60	-	-	-	-	-	-

*Number of spray.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

**Calculated on the basis of 20 replicates.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 21. Frequency (Percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with urea.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	30	35	35	20	15	10	25	30	35	20	20	30	25	30	35	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	30	35	40	5	10	10	10	15	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	30	35	35	-	-	-	-	-	-	25	20	10	30	25	20
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	20	25	35	20	10	5	30	15	10
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	10	15	20	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	20	25	30
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	15	20	25	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	25	30	35	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	15	25	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	30	35	40	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	65	70	75	60	50	40	65	60	50	50	55	60	55	60	70	55	50	45	60	55	55
A. flavus Link	45	50	60	50	55	65	40	35	30	45	30	35	45	50	60	55	60	75	30	30	25	45	40	30
A. funiculosus G. Smith	10	10	10	15	20	20	20	10	-	30	25	-	15	20	20	20	25	30	10	5	-	15	20	-
A. niger van Tieghem	20	25	30	25	35	40	30	25	20	35	30	30	70	80	85	80	90	95	45	40	30	50	45	35
A. luchuensis Inui	10	15	10	15	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	15	25	25	30	30	30	35	35	35	30	40	45	40	45	50	15	10	5	30	20	10
A. nidulans (Eidam) Winter	30	30	35	35	40	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	20	20	25	25	30	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	15	30	20	10	5	25	20	10	25	30	35	30	40	45	20	15	15	30	20	20
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	35	30	25	20	25	25	25	40	45	10	5	5	15	10	10
A. terricola Marchal	30	35	40	35	40	45	35	30	15	40	35	30	30	40	50	40	50	60	15	10	5	20	15	10
A. sydowi (Bainier & Sartory) Thom &	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	40	45	55	25	20	15	35	25	20
Chaetomium flavum Omvik	-	10	10	-	20	20	-	15	30	-	20	50	-	5	10	-	10	20	-	10	20	-	20	25
C. magnum Bainier	-	-	15	-	-	20	-	-	25	-	-	50	-	-	5	-	-	20	-	-	25	-	-	35
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	40	45	50	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	35	40	50	-	-	-	-	-	-	50	55	60	55	60	60	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	20	30	40	-	-	-	-	-	-	20	25	30	25	30	35	-	-	-	-	-	-
C. asperum Marchal	10	10	10	15	15	15	-	-	-	-	-	-	-	-	10	-	-	20	-	-	10	-	-	20
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	15	20	20	-	-	-	-	-	-	10	15	20	20	25	30
Trichoderma viride Pers. ex Fr.	30	30	35	35	40	40	-	-	-	-	-	-	25	30	35	30	35	40	10	15	20	20	30	35
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	10	15	15	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	70	75	75	-	-	-	-	-	-	15	25	30	20	35	40
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	20	25	30	-	-	-	-	-	-	10	15	20	15	20	25
Fusidium viride Grove	-	-	10	-	-	30	-	-	-	-	-	-	-	-	15	-	-	30	-	-	-	-	-	-
Drechslera australiensis Subram.& Jain ex M.B. Ellis	10	15	15	20	25	30	20	30	40	25	35	45	10	10	10	15	20	25	20	30	40	25	35	45
Curvularia pallescens Boedijn	10	10	10	15	20	20	10	10	10	15	20	20	15	10	15	20	25	30	25	30	35	30	35	45
Alternaria alternata (Fr.) Keissler	-	-	-	-	-	-	10	10	10	15	20	25	10	10	10	15	20	25	15	20	25	20	25	35
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	15	20	30	-	-	-	-	-	-	10	10	15	15	20	25
Hormiscium stilbosporum (Corda) Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	20	25	35
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	10	20	-	-	-	-	-	-	-	5	10	-	15	20
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	10	15	-	-	-	-	-	-	-	5	10	-	10	15
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	5	20	25	-	-	-	-	-	-	10	10	10	20	25	30
Black sterile mycelium	10	15	20	20	30	40	-	-	-	-	-	-	20	25	30	30	35	40	-	-	-	-	-	-

* Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 24. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with F. udum. sprayed with muriate of potash.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
<u>Rhizopus oryzae</u> Went & Gerlings	15**	25	30	20	30	40	20	15	10	25	35	40	10	15	30	20	25	35	-	-	-	-	-	-
<u>R. nigricans</u> Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	30	35	40	15	10	10	20	25	30
<u>Cunninghamella echinulata</u> Thaxter	-	-	-	-	-	-	10	10	10	15	20	20	-	-	-	-	-	-	20	15	15	25	25	35
<u>C. bertholletiae</u> Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	25	25	25	10	10	15	15	20	25
<u>Circinella tenella</u> (Ling-Young) Zycha	20	25	30	25	35	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Mucor globosus</u> Fischer	-	-	-	-	-	-	10	15	30	15	25	35	-	-	-	-	-	-	-	-	-	-	-	-
<u>M. mucedo</u> (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	25
<u>Syncephalastrum racemosum</u> (Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	20	35	40	-	-	-	-	-	-
<u>Aspergillus fumigatus</u> Fresenius	60	60	60	65	70	75	60	55	50	65	75	80	50	60	60	60	65	70	50	45	40	55	60	70
<u>A. flavus</u> Link	40	45	50	40	50	60	45	40	35	50	60	65	35	40	45	40	45	50	30	30	25	40	50	60
<u>A. funiculosus</u> G. Smith	20	25	30	25	30	35	30	-	-	35	-	-	15	20	20	20	25	30	25	15	-	25	30	-
<u>A. niger</u> van Tieghem	15	15	15	15	20	25	15	10	5	20	25	30	80	85	100	90	95	100	60	35	40	65	70	75
<u>A. luchuensis</u> Inui	10	10	15	15	20	20	15	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>A. terreus</u> Thom	-	-	5	-	-	-	-	-	-	-	-	-	20	35	40	35	40	45	15	10	5	20	25	30
<u>A. nidulans</u> (Eidam) Winter	-	5	10	-	-	20	-	10	5	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>A. sulphureus</u> (Fresenius) Thom & Church	10	10	20	15	20	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>A. candidus</u> Link	-	10	15	-	15	20	15	10	5	15	20	20	30	35	40	35	40	45	20	15	15	25	30	30
<u>Cephalosporium curtipes</u> Saccardo	25	25	30	30	35	40	-	-	-	-	-	-	55	60	70	60	75	80	-	-	-	-	-	-
<u>C. roseo-griseum</u> Saksena	10	15	20	15	20	25	-	-	-	-	-	-	25	30	40	30	35	45	-	-	-	-	-	-
<u>Trichoderma viride</u> Pers. ex Fr.	20	25	25	20	30	40	-	-	-	-	-	-	30	35	40	35	40	45	20	15	10	20	25	30
<u>T. album</u> Preuss	10	10	10	15	25	-	-	-	-	-	-	-	10	15	20	15	20	25	10	10	5	15	20	25
<u>Fusarium udum</u> Butler	-	-	-	-	-	-	70	90	85	55	45	35	-	-	-	-	-	-	20	30	40	5	-	-
<u>Curvularia pallescens</u> Boedijn	-	10	15	-	10	5	-	20	25	-	15	20	-	5	10	-	-	5	-	10	30	-	10	20
<u>Drechslera australiensis</u> Subram. & Jain ex M.B. Ellis	-	-	10	-	-	5	15	15	20	10	10	15	-	15	20	-	10	15	-	30	35	-	30	25
<u>D. hawaiiensis</u> Subram.& Jain ex M.B. Ellis	-	-	5	-	-	-	5	10	15	-	5	10	-	-	15	-	-	10	-	10	20	-	5	10
<u>Helminthosporium sativum</u> Pammel, King & Bakke	-	-	20	-	-	15	-	-	35	-	-	30	-	-	10	-	-	5	-	5	25	-	5	10
<u>Pullularia pullulans</u> (de Bary) Berkhout	15	20	25	10	15	15	20	25	30	15	20	25	10	15	20	5	10	15	15	30	40	15	10	10
<u>Rhizoctonia solani</u> Kuhn	-	-	-	-	-	-	-	10	20	-	5	15	-	-	-	-	-	-	-	10	20	-	10	10
<u>Sclerotium rolfsii</u> Saccardo	-	-	-	-	-	-	-	15	20	-	10	15	-	-	-	-	-	-	-	10	30	-	10	10
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	15	20	30	-	-	-	-	-	-	15	20	35	25	20	30
Black sterile mycelium	30	35	35	25	30	30	-	-	-	-	-	-	40	45	50	25	30	30	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

ICP = Inoculated control plants.

UP = Uninoculated plants.

IP = Inoculated plants.

(c) **Pesticides:**

A perusal of tables 25, 27, 29, 31, 33, 35, 37, 39 and 41 reveals that the number of fungal species recorded from the rhizosphere of pigeon pea sprayed with 1500 ppm of bavistin after I, II and III spray was 18, 19, 18 in uninoculated plants and 19, 22, 23 in inoculated counterparts of cultivar T-21, 22, 24, 27 in uninoculated and 22, 25, 26 in inoculated plants of cultivar BDN-1; with 1500 ppm of vitavax after I, II and III spray 18, 17, 19 in uninoculated and 21, 23, 22 in inoculated plants of T-21, 22, 22, 24 in uninoculated and 23, 22, 24 in inoculated plants of BDN-1; with 1500 ppm of brassicol after I, II and III spray 18, 19, 23 in uninoculated and 20, 21, 23 in inoculated plants of T-21, 20, 20, 24 in uninoculated and 23, 22, 25 in inoculated plants of BDN-1; with 1500 ppm of benlate after I, II and III spray 18, 20, 23 in uninoculated and 21, 24, 23 in inoculated plants of T-21, 21, 23, 24 in uninoculated and 24, 27, 27 in inoculated plants of BDN-1; with 1500 ppm of fytolan after I, II and III spray 18, 19, 23 in uninoculated and 21, 22, 24 in inoculated plants of T-21, 21, 21, 26 in uninoculated and 23, 24, 24 in inoculated plants of BDN-1; with 1500 ppm of captan after I, II and III spray 18, 19, 22 in uninoculated and 21, 24, 25, in inoculated plants of T-21, 19, 21, 24 in uninoculated and 23, 25, 26 in inoculated plants of BDN-1; with 1500 ppm of wettable sulphur after I, II and III spray 17, 20, 23 in uninoculated and 21, 24, 25 in inoculated plants of T-21, 22, 23, 26 in uninoculated and 23, 26, 28 in inoculated plants of BDN-1; with 100 ppm of 2,4-dichlorophenoxyacetic acid after I, II and III spray 18, 18, 21 in uninoculated and 21, 23, 23 in inoculated plants of T-21, 21, 21, 25 in uninoculated and 23, 23, 23 in inoculated plants of BDN-1; with 100 ppm of streptomycin after I, II and III spray 18, 20, 24, in uninoculated and 22, 25, 25 in inoculated plants of T-21, 22, 24, 27 in uninoculated and 22, 25, 26 in inoculated plants of BDN-1 for the corresponding periods as against 18, 20, 23 in uninoculated and 21, 24, 24 in inoculated control plants of T-21, 22, 23, 26 in uninoculated and 23, 26. 26 in inoculated control plants of BDN-1.

From tables 26, 28, 30, 32, 34, 36, 38, 40 and 42, it is evident that number of fungal species isolated from the rhizoplane treated with 1500 ppm of bavistin after I, II and III spray was 14, 16, 18 in uninoculated plants and 14, 19, 19 in inoculated counterparts of cultivar T-21, 16, 17, 20 in uninoculated and 15, 18, 20 in inoculated plants of cultivar BDN-1; with 1500 ppm of vitavax after I, II and III spray 14, 16, 19 in uninoculated and 14, 16, 17 in inoculated plants of T-21, 16, 16, 20 in uninoculated and 15, 20, 20 in inoculated plants of BDN-1; with 1500 ppm of brassicol after I, II and III spray 14, 15, 17 in uninoculated and 15, 18, 19 in inoculated plants of T-21, 16, 19, 20 in uninoculated and 15, 20, 21 in inoculated plants of BDN-1; with 1500 ppm of benlate after I, II and III spray 14, 17, 19 in uninoculated and 13, 16, 17 in inoculated plants of T-21, 16, 17, 20 in uninoculated and 14, 21, 21 in inoculated plants of BDN-1; with 1500 ppm of fytolan after I, II and III spray 14, 16, 19 in uninoculated and 14, 18, 19 in inoculated plants of T-21, 16, 19, 20 in uninoculated and 16, 21, 22 in inoculated plants of BDN-1; with 1500 ppm of captan after I, II and III spray 14, 16, 20 in uninoculated and 11, 16, 17 in inoculated plants of T-21, 16, 17, 20 in uninoculated and 15, 21, 21 in inoculated plants of BDN-1; with 1500 ppm of wettable sulphur after I, II and III spray 15, 17, 20 in uninoculated and 14, 17, 18 in inoculated plants of T-21, 16, 18, 20 in uninoculated and 15, 21, 20 in inoculated plants of BDN-1; with 100 ppm of 2,4-dichlorophenoxy-acetic acid after I, II and III spray 14, 16, 18 in uninoculated and 13, 18, 15 in inoculated plants of T-21, 15, 16, 19 in uninoculated and 15, 20, 18 in inoculated plants of BDN-1; with 100 ppm of streptomycin after I, II and III spray 14, 17, 20 in uninoculated and 14, 17, 17 in inoculated plants of T-21, 15, 17, 19 in uninoculated and 16, 21, 20 in inoculated plants of BDN-1 for the corresponding periods as against 14, 17, 21 in uninoculated and 14, 16, 17 in inoculated control plants of T-21, 16, 18, 20 in uninoculated and 15, 21, 20 in inoculated control plants of BDN-1.

Fig. 3 & 4 and table 10 shows that population of fungi in the rhizosphere of plants sprayed with 1500 ppm bavistin after I, II and III spray was 53000, 49500, 44000 in uninoculated plants and 70000, 85000, 120000 in inoculated counterparts of cultivar T-21, 35000, 33000, 32000 in uninoculated and 40000, 60000, 80000 in inoculated plants of cultivar BDN-1; with 1500 ppm of vitavax after I, II and III spray 55000, 51000, 48000 in uninoculated and 74000, 82000, 110000 in inoculated plants of T-21, 36800, 35000, 33000 in uninoculated and 41000, 61000, 82000 in inoculated plants of BDN-1; with 1500 ppm of brassicol after I, II and III spray 60300, 56500, 52000 in uninoculated and 76000, 80000, 105000 in inoculated plants of T-21, 39000, 37000, 35100 in uninoculated and 44000, 62800, 84000 in inoculated plants of BDN-1; with 1500 ppm of benlate after I, II and III spray 62800, 58900, 55000 in uninoculated and 76500, 81000, 108000 in inoculated plants of T-21, 40200, 38000, 36300 in uninoculated and 45000, 63000, 85000 in inoculated plants of BDN-1; with 1500 ppm of fytolan after I, II and III spray 62000, 57000, 55000 in uninoculated and 77000, 82000, 107000 in inoculated plants of T-21, 40500, 39000 35000 in uninoculated and 43000, 61900, 81200 in inoculated plants of BDN-1; with 1500 ppm of captan after I, II and III spray 63000, 56000, 53000 in uninoculated and 76700, 83000, 103000 in inoculated plants of T-21, 41300, 39400, 35800 in uninoculated and 43800, 63800, 85900 in inoculated plants of BDN-1; with 1500 ppm of wettable sulphur after I, II and III spray 64500, 59800, 57000 in uninoculated and 79000, 80000, 100000 in inoculated plants of T-21, 42000, 40000, 37000 in uninoculated and 45800, 65000, 87000 in inoculated plants of BDN-1; with 100 ppm of 2,4- dichlorophenoxyacetic acid after I, II and III spray, 58000, 45000, 42000 in uninoculated and 80000, 74000, 71000 in inoculated plants of T-21, 36000, 31500, 29800 in uninoculated and 41000, 38000, 37000 in inoculated plants of BDN-1; with 100 ppm of streptomycin after I, II and III spray 69500, 101000, 136000 in uninoculated and 82000, 122000, 201750 in inoculated plants of T-21, 43300, 59200, 80300 in uninoculated and 53000, 76000, 117000 in inoculated plants of BDN-1 for the corresponding periods as against 66000, 95000, 130000 inuuninoculated and 80000, 120000, 200600 in inoculated control plants of T-21, 40000, 55000, 76000 in uninoculated and 45000, 70000, 110000 in inoculated control plants of BDN-1. However, the population of fungi in the non-rhizosphere was 9500, 11500, 12000 for the corresponding periods.

It is evident from table 25 that the frequency of majority of the fungi decreased in the rhizosphere of uninoculated plants of both the cultivars T-21 and BDN-1, with the application of 1500 ppm of bavistin after I, II and III spray in comparison to control. In the cultivar T-21, the frequency of Rhizopus oryzae, Aspergillus fumigatus, A. flavus, A. niger, A. luchuensis, Cephalosporium curtipes, Trichoderma viride, Drechslera australiensis, Curvularia pallescens and black sterile mycelium decreased after each spray; Circinella tenella, A. funiculosus, A. terreus after I and II spray; Chaetomium flavum, C. roseo-griseum, C. aspermum after II and III spray; A. candidus, C. magnum, Gelasinospora cerealis and Eusidium viride after III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. funiculosus, A. niger, C. curtipes, T. viride, D. australiensis, C. pallescens, Alternaria alternata and black sterile mycelium decreased after each spray; C. flavum, C. aspermum, E. viride after III spray. A similar pattern was noticed in other fungi. Lower frequency value in the rhizosphere of uninoculated plants of cultivar T-21 after 1500 ppm of bavistin was recorded for most of the fungi viz., R. oryzae, C. tenella, Aspergillus funiculosus, A. niger, A. luchuensis, A. terreus, A. nidulans, C. flavum, C. curtipes, G. cerealis, T. viride, D. australiensis. Other forms followed a similar trend except A. fumigatus. In the cultivar BDN-1, higher frequency value was recorded for Aspergillus niger; and lower frequency for majority of the fungi such as - R. oryzae, C. bertholletiae, A. funiculosus, A. candidus, A. ustus, C. flavum, T. viride, D. australiensis, C. pallescens, A. alternata and black sterile mycelium. Other fungi exhibited a similar pattern (Table 25). In the rhizosphere of inoculated plants of cultivar

T-21 with the application of 1500 ppm of bavistin after I, II and III spray, the frequency of R. oryzae, Cunninghamella echinulata, A. fumigatus, A. flavus, A. niger, A. terreus, A. ustus and A. terricola increased; however, R. oryzae and C. echinulata after I spray decreased. On the other hand, the frequency of Mucor globosus, M. racemosus, Mortierella alpina, Monosporium olivaceum, Fusarium udum, D. australiensis, C. pallescens, A. alternata and Helminthosporium sativum decreased after each spray; however, the frequency of M. racemosus, M. alpina, M. olivaceum, C. pallescens and H. sativum after I spray; M. globosus after I and II spray increased. The frequency of A. funiculosus after I and II spray; C. flavum, Sclerotium rolfsii after II and III spray; C. magnum after III spray decreased. In the cultivar BDN-1, the frequency of Rhizopus nigricans, C. echinulata, C.bertholletiae Mucor mucedo, A. fumigatus, A. flavus, A. funiculosus, A. niger, A. terreus, A. ustus, A. terricola, A. sydowi and T. viride increased after each spray; however, the frequency of A. funiculosus, A. niger, A. sydowi after I spray decreased. The frequency of Cephalosporium aspermum increased after II and III spray. On the other hand, the frequency of Aspergillus candidus, M. olivaceum, Fusarium oxysporum, D. australiensis, C. pallescens, A. alternata, Hormiscium stilbosporum and yellow sterile mycelium decreased after each spray; however, the frequency of M. olivaceum after I spray; A. candidus after II spray increased. The frequency of F. udum, H. sativum after I and II spray; C. flavum, S. rolfsii and yellow sterile mycelium after II and III spray; C. magnum, Rhizoctonia solani after III spray decreased. Higher frequency value in the rhizosphere of inoculated plants of cultivar T-21 after 1500 ppm of bavistin spray was noticed for A. fumigatus, A. flavus, A. niger, A. terreus, A. ustus and A. terricola; and lower for R. oryzae, M. globosus, M. racemosus, M. alpina, A. candidus, C. flavum, C. magnum, M. olivaceum, D. australiensis, C. pallescens, A. alternata, H. sativum, R. solani and yellow sterile mycelium. In the cultivar BDN-1, higher frequency value was exhibited by A. fumigatus, A. flavus and A. niger; and lower by R. nigricans, C. bertholletiae, A. funiculosus, A. candidus, C. flavum, C. magnum, C. aspermum, M. olivaceum, F. udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, H. stilbosporum, R. solani, S. rolfsii and yellow sterile mycelium (Table 25).

A perusal of table 26 shows that the frequency of most of the fungi in the rhizoplane of uninoculated plants of both the cultivar T-21 and BDN-1 decreased with the application of 1500 ppm of bavistin after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, A. sulphureus, Cephalosporium curtipes, Trichoderma viride, Pullularia pullulans and black sterile mycelium decreased after each spray; T. album after I and II spray; A. candidus, Curvularia pallescens after II and III spray; A. nidulans, Drechslera australiensis, Helminthosporium sativum after III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, C. curtipes, T. viride, P. pullulans and black sterile mycelium decreased after each spray; D. australiensis after II and III spray; C. pallescens, D. hawaiiensis, H. sativum after III spray. A similar trend was followed by other fungi. Higher frequency value in the rhizoplane of uninoculated plants of cultivar T-21, after 1500 ppm of bavistin spray was shown by A. fumigatus; and lower by R. oryzae, C. tenella, A. funiculosus, A. niger, A. luchuensis, A. nidulans, A. sulphureus, A. candidus, C. curtipes, C. roseo-griseum, T. viride, T. album, D. australiensis, H. sativum, P. pullulans and black sterile mycelium. In the cultivar BDN-1, higher frequency value was recorded for A. fumigatus,

A. niger and C. curtinea; and lower for R. oryzae, R. nigricans, C. bertholletiae, S. racemosum, A. funiculosus, A. terreus, A. candidus, C. roseo-griseum, T. viride, T. album, C. pallescens, D. australiensis, D. hawaiiensis, H. sativum, P. pullulans and black sterile mycelium (Table 26). In the rhizoplane of inoculated plants of cultivar T-21, with the application of 1500 ppm of bavistin after I, II and III spray, the frequency of R. oryzae, Cunninghamella echinulata, Mucor globosus, A. fumigatus, A. flavus, A. niger increased after eah spray; A. nidulans after II and III spray. On the other hand, the frequency of Aspergillus candidus, Fusarium udum, D. australiensis, D. hawaiiensis, P. pullulans and yellow sterile mycelium decreased after each spray; C. pallescens, H. sativum, Rhizoctonia solani and Sclerotium rolfsii after II and III spray. In the cultivar BDN-1, the frequency of Rhizopus nigricans, C. echinulata, C. bertholletiae, Mucor mucedo, A. fumigatus, A. funiculosus, A. flavus, A. niger, A. candidus, T. viride and T. album increased after each spray. On the other hand, the frequency of P. pullulans and yellow sterile mycelium decreased after each spray; F. udum after I spray; C. pallescens, D. australiensis, D. hawaiiensis, H. sativum, R. solani and S. rolfsii after II and III spray. Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21 after 1500 ppm of bavistin spray was shown by A. fumigatus and A. flavus; and lower by C. echinulata, A. funiculosus, A. nidulans,

A. candidus, E. udum, C. pallescens, D. australiensis, D. hawaiiensis, H. sativum, P. pullulans, R. solani and S. rolfsii. In the cultivar BDN-1, higher frequency value was recorded for A. fumigatus, A. flavus and A. niger; and lower for C. bertholletiae, A. funiculosus, E. udum, C. pallescens, D. australiensis, D. hawaiiensis, H. sativum, P. pullulans, R. solani, S. rolfsii and yellow sterile mycelium (Table 26).

It is clear from table 27 that in the rhizosphere of uninoculated plants of both the cultivars T-21 and BDN-1, the frequency of majority of the fungi decreased with the application of 1500 ppm of vitavax after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, A. nidulans, Cephalosporium curtipes, Trichoderma viride, Drechslera australiensis, Curvularia pallescens and black sterile mycelium decreased after each spray; A. funiculosus, C. aspermum after I spray; A. luchuensis after I and II spray; Chaetomium flavum after II and III spray; C. magnum, Gelasinospora cerealis and Fusidium viride after III spray. Rest of the forms followed similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, C. curtipes, T. viride, D. australiensis, C. pallescens, Alternaria alternata and black sterile mycelium decreased after each spray; A. _funiculosus_ after I and II spray; C. _flavum_ after II and III spray; C. _magnum_, C. _aspermum_, E. _viride_ after III spray. Similar pattern was followed by other fungi. Higher frequency value in the rhizosphere of uninoculated plants of cultivar T-21, after 1500 ppm of vitavax spray, was recorded for A. _fumigatus_; and lower for R. _oryzae_, C. _tenella_, A. _flavus_, A. _funiculosus_, A. _niger_, A. _luchuensis_, A. _terreus_, A. _nidulans_, A. _sulphureus_, A. _terricola_, C. _flavum_, C. _magnum_, C. _curtipes_, C. _roseo-griseum_, C. _aspermum_, C. _cerealis_, T. _viride_, E. _viride_, D. _australiensis_, C. _pallescens_ and black sterile mycelium. In the cultivar BDN-1, higher frequency value was noticed for _Aspergillus niger_; and lower for R. _oryzae_, R. _nigricans_, C. _bertholletiae_, A. _fumigatus_, A. _funiculosus_, A. _terreus_, A. _candidus_, A. _ustus_, A. _sydowi_, C. _flavum_, C. _magnum_, _Penicillium chrysogenum_, C. _roseo-griseum_, C. _aspermum_, T. _viride_, T. _lignorum_, E. _viride_, D. _australiensis_ and A. _alternata_ (Table 27). In the rhizosphere of inoculated plants of cultivar T-21, with the application of 1500 ppm of vitavax after I, II and III spray, the frequency of A. _fumigatus_, A. _flavus_, A. _niger_, A. _nidulans_, A. _ustus_, _Monosporium olivaceum_ and yellow sterile mycelium increased after each spray; A. _candidus_ after I and II spray. On the other hand, the frequency of R. _oryzae_, _Cunninghamella achinulata_, _Mucor globosus_, M. _racemosus_, _Mortierella alpina_, _Aspergillus terricola_, _Fusarium udum_, D. _australiensis_, C. _pallescens_, A. _alternata_ and

H. sativum decreased after each spray; A. funiculosus, F. oxysporum after I and II spray; C. flavum, Rhizoctonia solani after II and III spray; C. magnum, Sclerotium rolfsii after III spray. In the cultivar BDN-1, the frequency of Rhizopus nigricans, Mucor mucedo, A. fumigatus, A. flavus, A. niger, A. terricola, A. sydowi and yellow sterile mycelium increased after each spray; however the frequency of R. nigricans, A. niger, A. terricola, A. sydowi and yellow sterile mycelium decreased after I spray. On the other hand, the frequency of C. echinulata, Aspergillus candidus, M. olivaceum, T. viride, F. udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, H. sativum and Hormiscium stilbosporum decreased after eadh spray; however the frequency of C. echinulata increased after III spray. The frequency of Aspergillus funiculosus after I spray; C. bertholletiae, A. terreus after I and II spray; C. flavum, S. rolfsii after II and III spray; C. magnum, C. aspermum, R. solani after III spray decreased. Higher frequency value in the rhizosphere of inoculated plants of cultivar T-21, after 1500 ppm of vitavax spray, was shown by A. fumigatus, A. flavus, A. niger, A. terreus and A. ustus; and lower by R. oryzae, C. echinulata, M. globosus, M. mucedo, A. candidus, A. terricola, C. flavum, C. magnum, M. olivaceum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, H. sativum, R. solani, S. rolfsii and yellow sterile mycelium. In the cultivar BDN-1, higher frequency value was recorded for <u>A. fumigatus</u>, <u>A. flavus</u> and <u>A. niger</u>; and lower for <u>R. nigricans</u>, <u>C. echinulata</u>, <u>C. bertholletiae</u>, <u>M. mucedo</u>, <u>A. terreus</u>, <u>A. candidus</u>, <u>A. ustus</u>, <u>A. terricola</u>, <u>C. flavum</u>, <u>C. magnum</u>, <u>C. aspermum</u>, <u>M. olivaceum</u>, <u>T. viride</u>, <u>F. udum</u>, <u>F. oxysporum</u>, <u>D. australiensis</u>, <u>C. pallescens</u>, <u>A. alternata</u>, <u>H. sativum</u>, <u>H. stilbosporum</u>, <u>R. solani</u>, <u>S. rolfsii</u> and yellow sterile mycelium (Table 27).

A perusal of table 28 reveals that in the rhizoplane of uninoculated plants of both the cultivars T-21 and BDN-1 the frequency of majority of the fungi decreased with the application of 1500 ppm of vitavax after I, II and III spray. In the cultivar T-21, the frequency of <u>Rhizopus oryzae</u>, <u>Circinella tenella</u>, <u>Aspergillus fumigatus</u>, <u>A. flavus</u>, <u>A. niger</u>, <u>Cephalosporium curtipes</u>, <u>Trichoderma viride</u>, <u>Pullularia pullulans</u> and black sterile mycelium decreased after each spray; <u>A. candidus</u>, <u>Curvularia pallescens</u> after II and III spray; <u>A. nidulans</u>, <u>Drechslera australiensis</u> and <u>Helminthosporium sativum</u> after III spray. Other forms followed a similar pattern. In the cultivar BDN-1, the frequency of <u>R. oryzae</u>, <u>Cunninghamella bertholletiae</u>, <u>Syncephalastrum racemosum</u>, <u>A. fumigatus</u>, <u>A. flavus</u>, <u>A. niger</u>, <u>A. terreus</u>, <u>C. curtipes</u>, <u>T. viride</u>, <u>P. pullulans</u> and black sterile mycelium decreased after each spray; <u>D. australiensis</u> after II and III spray; <u>D. hawaiiensis</u>, <u>C. pallescens</u> and

H. sativum after III spray. Higher frequency value in the rhizoplane of uninoculated plants of cultivar T-21 after 1500 ppm of vitavax spray was noticed for A. fumigatus and lower for R. oryzae, C. tenella, A. funiculosus, A. niger, A. luchuensis, A. nidulans, A. sulphureus, A. candidus, C. curtipes, C. roseo-griseum, T. viride, T. album, D. australiensis, C. pallescens, H. sativum, P. pullulans. In the cultivar BDN-1, higher frequency value was shown by Aspergillus niger, C. curtipes and black sterile mycelium; and lower by R. oryzae, R. nigricans, C. bertholletiae, S. racemosum, A. funiculosus, A. terreus, A. candidus, C. roseo-griseum, T. viride, T. album, D. australiensis, D. hawaiiensis, C. pallescens, H. sativum and P. pullulans (Table 29). In the rhizoplane of inoculated plants of cultivar T-21, with the application of 1500 ppm of vitavax after I, II and III spray, the frequency of R. oryzae, Mucor globosus, A. fumigatus, A. flavus, A. niger, A. nidulans, and A. candidus increased after each spray; however, the frequency of A. fumigatus decreased after I spray. The frequency of Aspergillus luchuensis increased after I spray. On the other hand, the frequency oc Cunninghamella echinulata Fusarium udum, D. australiensis and yellow sterile mycelium decreased after each spray; C. pallescens, Rhizoctonia solani and Sclerotium rolfsii after II and III spray; H. sativum after

III spray. In the cultivar BDN-1, the frequency of *Rhizopus nigricans*, *C. echinulata*, *Mucor mucedo*, *A. fumigatus*, *A. flavus*, *A. funiculosus*, *A. niger*, *A. terreus*, *T. viride*, *T. album* increased after each spray; however, the frequency of *R. nigricans*, *C. echinulata*, *A. fumigatus*, *A. flavus*, *A. funiculosus*, *A. terreus*, *T. viride* after I spray; *A. niger* and *T. album* after I and II spray decreased. On the other hand, the frequency of *C. bertholletiae*, *Aspergillus candidus*, *P. pullulans* and yellow sterile mycelium decreased after each spray; *F. udum* after I and II spray; *D. australiensis*, *D. hawaiiensis*, *C. pallescens*, *R. solani*, *S. rolfsii* after II and III spray; *H. sativum* after III spray. Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21, after 1500 ppm of vitavax spray, was exhibited by *A. fumigatus* and *A. flavus*; and lower by *C. echinulata*, *A. luchuensis*, *A. nidulans*, *D. australiensis*, *D. hawaiiensis*, *C. pallescens*, *H. sativum*, *P. pullulans*, *R. solani* and *S. rolfsii*. In the cultivar BDN-1, higher frequency value was shown by *A. fumigatus* and *A. niger*, and lower by *R. nigricans*, *C. echinulata*, *C. bertholletiae*, *A. terreus*, *A. candidus*, *T. viride*, *T. album*, *F. udum*, *D. australiensis*, *D. hawaiiensis*, *C. pallescens*, *R. solani*, *S. rolfsii* and yellow sterile mycelium (Table 28).

In the rhizosphere of uninoculated plants of both the cultivar T-21 and BDN-1 (Table 29), the frequency of majority of the fungi decreased with the application of 1500 ppm of brassicol after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Trichoderma viride, Drechslera australiensis, Curvularia pallescens and black sterile mycelium decreased after each spray; Chaetomium flavum after II and III spray; C. magnum, Gelasinospora cerealis, Fusidium viride after III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, C. curtipes, T. viride, D. australiensis, C. pallescens and Alternaria alternata decreased after each spray; C. flavum, C. aspermum, T. lignorum, F. viride after III spray. Similar pattern was followed by other fungi. Higher frequency value in the rhizosphere of uninoculated plants of cultivar T-21, after 1500 ppm of brassicol spray was noticed for A. fumigatus; and lower for R. oryzae, C. tenella, A. funiculosus, A. niger, A. luchuensis, A. terreus, A. nidulans, A. sulphureus, A. candidus, A. terricola, C. flavum, C. magnum, C. curtipes, C. roseo-griseum, C. aspermum, G. cerealis, T. viride, F. viride, D. australiensis, C. pallescens and black sterile mycelium. In the cultivar BDN-1, higher frequency value was recorded for *Aspergillus niger*; and lower for *R. oryzae*, *R. nigricans*, *C. bertholletiae*, *S. racemosum*, *A. flavus*, *A. funiculosus*, *A. terreus*, *A. candidus*, *A. ustus*, *A. terricola*, *A. sydowi*, *C. flavum*, *Penicillium chrysogenum*, *Cephalosporium roseo-griseum*, *C. aspermum*, *T. viride*, *T. lignorum*, *F. viride*, *D. australiensis*, *C. pallescens* and *A. alternata* (Table 29). In the rhizosphere of inoculated plants of cultivar T-21 with the application of 1500 ppm of brassicol after I, II and III spray, the frequency of *Cunninghamella echinulata*, *Mucor globosus*, *M. racemosus*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terreus* and yellow sterile mycelium increased after each spray; however, that of *M. globosus*, *A. fumigatus*, *A. niger* after I spray; *C. echinulata* after I and II spray decreased. On the other hand, the frequency of *R. oryzae*, *Mortierella alpina*, *Aspergillus ustus*, *A. terricola*, *Monosporium olivaceum*, *Fusarium udum*, *D. australiensis*, *C. pallescens*, *A. alternata*, and *Helminthosporium sativum* decreased after each spray; *F. oxysporum* after I spray; *A. candidus* after I and II spray; *C. flavum* after II and III spray; *C. magnum* and *Rhizoctonia solani* after III spray. In the cultivar BDN-1, the frequency of *Rhizopus nigricans*, *C. echinulata*, *A. fumigatus*, *A. flavus* *A. niger*, *A. candidus*, *A. ustus*, *A. terricola*, *A. sydowi*, Monosporium olivaceum, T. viride and yellow sterile mycelium increased after each spray with the exception of R. nigricans, C. echinulata, A. niger, A. sydowi, where the frequency decreased after I spray. On the other hand, the frequency of C. bertholletiae, E. udum, D. australiensis, C. pallescens and Hormiscium stilbosporum decreased after each spray except C. bertholletiae where the frequency increased after II and III spray. The frequency of Aspergillus terreus, Fusarium oxysporum after I and II spray; C. flavum after II and III spray; C.magnum Cephalosporium aspermum, R. solani and S. rolfsii after III spray decreased. Higher frequency value in the rhizosphere of inoculated plants of cultivar T-21, after 1500 ppm of brassicol spray was recorded for A. fumigatus, A. flavus, and A. terreus; and lower for R. oryzae, M. globosus, M. alpina, A. funiculosus, A. candidus, A. ustus, A. terricola, C. flavum, C. magnum, M. olivaceum, D. australiensis, C. pallescens, A. alternata, H. stilbosporum, R. solani, S. rolfsii and yellow sterile mycelium In the cultivar BDN-1, higher frequency value was noticed for A. fumigatus, A. flavus, and A. niger; and lower for R. nigricans, C. bertholletiae, M. mucedo, A. terricola, C. flavum, C. magnum, C. aspermum, E. udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, H. sativum, H. stilbosporum, R. solani, S. rolfsii and yellow sterile mycelium (Table 29).

A perusal of table 30 shows that the frequency of majority of the fungi in the rhizoplane of uninoculated plants of both the cultivars T-21 and BDN-1 decreased with the application of 1500 ppm of brassicol after I, II and III spray. In the cultivar T-21, the frequency of *Rhizopus oryzae*, *Circinella tenella*, *Aspergillus fumigatus*, *A. flavus*, *A. niger*, *Cephalosporium curtipes*, *Trichoderma viride*, *Pullularia pullulans*, and black sterile mycelium decreased after each spray; *C. roseo-griseum* after I spray, *T. album* after I and II spray; *A. candidus*, *Curvularia pallescens*, after II and III spray; *A. nidulans*, *Drechslera australiensis* and *Helminthosporium sativum* after III spray. Rest of the fungi followed the similar pattern. In the cultivar BDN-1, the frequency of *R. oryzae*, *Cunninghamella bertholletiae*, *Syncephalastrum racemosum*, *A. fumigatus*, *A. flavus*, *A. niger*, *C. curtipes*, *T. viride*, *P. pullulans* and black sterile mycelium decreased after each spray; *C. pallescens*, *D. australiensis*, *H. sativum* after II and III spray; and *D. hawaiiensis* after III spray. Lower frequency was exhibited by *R. oryzae*, *C. tenella*, *Aspergillus funiculosus*, *A. niger*, *A. luchuensis*, *A. nidulans*, *A. sulphureus*, *A. candidus*, *C. curtipes*, *C. roseo-griseum*, *T. viride*, *T. album*, *C. pallescens* *D. australiensis*, *H. sativum*, *P. pullulans* and black sterile mycelium in the rhizoplane of uninoculated plants of cultivar T-21, after 1500 ppm of brassicol spray. In the cultivar BDN-1, higher frequency value was recorded for *A. fumigatus* and *A. niger*;

and lower for R. oryzae, R. nigricans, C. bertholletiae, S. racemosum, A. funiculosus, A. candidus, C. curtipes, C. roseo-griseum, T. viride, T. album, C. pallescens, D. australiensis, D. hawaiiensis, H. sativum and P. pullulans (Table 30). In the rhizoplane of inoculated plants of cultivar T-21, with the application of 1500 ppm of brassicol after I, II and III spray, the frequency of R. oryzae, Cunninghamella echinulata, Mucor globosus, A. fumigatus, A. flavus, and A. niger increased after each spray; however, the frequency of R. oryzae, A. flavus, and A. niger decreased after I spray. The frequency of Aspergillus nidulans increased after II and III spray. On the other hand, the frequency of Aspergillus luchuensis, A. candidus, Fusarium udum, D. australiensis, P. pullulans, Rhizoctonia solani, Sclerotium rolfsii and yellow sterile mycelium decreased after each spray; C. pallescens, D. hawaiiensis after II and III spray; H. sativum, after III spray. In the cultivar BDN-1, the frequency of Rhizopus nigricans, C. bertholletiae, Mucor mucedo, A. fumigatus, A. flavus, A. funiculosus, A. niger, T. viride and T. album increased after each spray; however, the frequency of A. funiculosus after I spray; C. bertholletiae and A. niger after I and II spray decreased. The frequency of R. solani increased after II and III spray. On the other hand, the frequency of Aspergillus terreus, A. candidus, F. udum, P. pullulans, and yellow sterile mycelium decreased after each spray; D. australiensis, D. hawaiiensis and S. rolfsii after II and III spray. Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21, after 1500 ppm of brassicol spray, was noticed for A. fumigatus and A. flavus; and lower for R. oryzae, C. echinulata, A. funiculosus, A. niger, A. luchuensis, A. nidulans, A. candidus, Curvularia pallescens, D. australiensis, D. hawaiiensis, P. pullulans, R. solani and S. rolfsii. In the cultivar BDN-1, higher frequency value was recorded for A. fumigatus and A. niger; and lower for C. echinulata, C. bertholletiae, A. terreus, A. candidus, T. album, F. udum, C. pallescens, Drechslera hawaiiensis, H. sativum, P. pullulans, S. rolfsii and yellow sterile mycelium (Table 30).

A perusal of table 31 reveals that in the rhizosphere of uninoculated plants in cultivars T-21 and BDN-1, the frequency of majority of the fungi decreased with the application of 1500 ppm of benlate after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Trichoderma viride, Drechslera australiensis, Curvularia pallescens and black sterile mycelium decreased after each spray; A. candidus, Chaetomium flavum after II and III spray; Penicillium chrysogenum, Gelasinospora cerealis after III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of

R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, A. candidus, C. curtipes, T. viride and black sterile mycelium decreased after each spray; D. australiensis, C. pallescens after I and II spray; T. lignorum after II and III spray; C. asperum, Fusidium viride after III spray. Similar pattern was followed by rest of the fungi. Higher frequency value in the rhizosphere of uninoculated plants of cultivar T-21 after 1500 ppm of benlate spray was exhibited by A. fumigatus, and lower by R. oryzae, C. tenella, A. funiculosus, A. niger, A. luchuensis, A. terreus, A. nidulans, A. sulphureus, A. candidus, A. ustus, C. flavum, C. magnum, C. curtipes, C. roseo-griseum, C. asperum, G. cerealis, T. viride, F. viride, D. australiensis, C. pallescens and black sterile mycelium. In the cultivar BDN-1, higher frequency value was noticed for A. fumigatus and A. niger; and lower for R. oryzae, R. nigricans, C. bertholletiae, S. racemosum, A. funiculosus, A. terreus, A. candidus, A. ustus, A. terricola, A. sydowi, C. flavum, C. magnum, P. chrysogenum, C. roseo-griseum, C. asperum, Trichoderma lignorum, F. viride, D. australiensis, C. pallescens and Alternaria alternata (Table 31). In the rhizosphere of inoculated plants of cultivar T-21 with the application of 1500 ppm of benlate after I, II and III spray, the frequency of Aspergillus flavus, A. funiculosus, A. terreus, A. candidus, A. terricola and yellow sterile mycelium increased after each spray; however, the frequency of A. _flavus_, A. _funiculosus_, A. _candidus_, yellow sterile mycelium after I spray; A. _terricola_ after I and II spray decreased. On the other hand, the frequency of _Cunninghamella echinulata_, _Mucor globosus_, M. _racemosus_, _Mortierella alpina_, A. _fumigatus_, A. _niger_, _Monosporium olivaceum_, _Fusarium udum_, D. _australiensis_ and _Helminthosporium sativum_ decreased after each spray except M. _globosus_ where the frequency increased after I spray. The frequency of _Fusarium oxysporum_, C. _pallescens_ after I and II spray; A. _alternata_ after II spray; C. _flavum_, _Hormiscium stilbosporum_ after II and III spray; C. _magnum_ after III spray decreased. In the cultivar BDN-1, the frequency of R. _oryzae_, _Cunninghamella echinulata_, C. _bertholletiae_, _Mucor mucedo_, A. _fumigatus_, A. _funiculosus_, A. _flavus_, A. _terreus_, A. _candidus_, A. _ustus_, A. _terricola_, A. _sydowi_, _Cephalosporium aspermum_, T. _viride_ and yellow sterile mycelium increased after each spray; however, the frequency of C. _bertholletiae_, A. _fumigatus_, A. _terreus_, A. _candidus_, A. _terricola_ after I spray decreased. On the other hand, the frequency of M. _olivaceum_, F. _udum_, D. _australiensis_, C. _pallescens_ and A. _alternata_ decreased after each spray except M. _olivaceum_ after I spray, where the frequency did not change. The frequency of F. _oxysporum_ after I and II spray; C. _flavum_, _Rhizoctonia solani_, _Sclerotium rolfsii_ after II and III spray; C. _magnum_ after III spray decreased. Higher frequency value in the rhizosphere of inoculated plants of cultivar T-21, after 1500 ppm of benlate spray was recorded for Aspergillus flavus and F. udum; and lower for R. oryzae, C. echinulata, M. globosus, M. racemosus, M. alpina, A. funiculosus, A. niger, A. candidus, A. ustus, C. flavum, C. magnum, M. olivaceum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, H. sativum, R. solani, S. rolfsii and yellow sterile mycelium. In the cultivar BDN-1, higher frequency value was noticed for A. fumigatus and A. flavus; and lower for Rhizopus nigricans, C. bertholletiae, M. mucedo, A. funiculosus, A. terreus, A. candidus, A. ustus, C. flavum, C. magnum, Cephalosporium aspermum, F. udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, H. sativum, R. solani, S. rolfsii and yellow sterile mycelium (Table 31).

In the rhizoplane of uninoculated plants of cultivar T-21 and BDN-1, the frequency of majority of the fungi decreased with the application of 1500 ppm of benlate after I, II and III spray (Table 32). In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Pullularia pullulans and black sterile mycelium decreased after each spray; C. roseo-griseum after I and II spray; A. nidulans, A. candidus, Curvularia pallescens after II and III spray; Helminthosporium sativum after

III spray. Other fungi followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, C. curtipes, Trichoderma viride, P. pullulans and black sterile mycelium decreased after each spray; Drechslera australiensis after II and III spray; D. hawaiiensis and C. pallescens after III spray. Higher frequency value in the rhizoplane of uninoculated plants of cultivar T-21, after 1500 ppm of benlate spray, was noticed for A. fumigatus; and lower for C. tenella, A. funiculosus, A. niger A. luchuensis, A. nidulans, A. sulphureus, A. candidus, C. curtipes, C. roseo-griseum, T. viride, T. album, D. australiensis, D. hawaiiensis, C. pallescens, H. sativum, P. pullulans. In the cultivar BDN-1, higher frequency value was recorded for A. fumigatus, A. niger, C. curtipes, and black sterile mycelium; and lower for R. oryzae, C. bertholletiae, S. racemosum, A. funiculosus, A. candidus, C. roseo-griseum, T. album, D. australiensis, D. hawaiiensis, C. pallescens, H. sativum and P. pullulans (Table 32). In the rhizoplane of inoculated plants of cultivar T-21, with the application of 1500 ppm of benlate after I, II and III spray, the frequency of A. fumigatus, A. flavus, A. niger, A. candidus increased after each spray; however, the frequency of A. fumigatus, A. flavus adecreased after I spray. The frequency of Aspergillus nidulans increased after II and III spray except after II spray where it decreased. On the other hand, the frequency of *R. oryzae*, *C. bertholletiae*, *Mucor globosus*, *Fusarium udum*, *D. australiensis*, *P. pullulans* and yellow sterile mycelium decreased after each spray; *Aspergillus funiculosus*, *A. luchuensis* after I spray; *D. hawaiiensis*, *C. pallescens*, *Rhizoctonia solani*, *Sclerotium rolfsii* after II and III spray. In the cultivar BDN-1, the frequency of *Rhizopus nigricans*, *Mucor mucedo*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terreus*, *T. viride* and *T. album* increased after each spray except *R. nigricans*, *A. niger*, *A. terreus*, *T. viride*, *T. album* after I spray; *A. fumigatus*, *A. flavus* after I and II spray, where the frequency decreased. On the other hand, the frequency of *Cunninghamella echinulata*, *C. bertholletiae*, *Aspergillus candidus*, *Fusarium udum*, *P. pullulans* and yellow sterile mycelium decreased after each spray; *D. australiensis*, *D. hawaiiensis*, *H. sativum*, *R. solani* and *S. rolfsii* after II and III spray. Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21 after 1500 ppm of benlate spray was shown by *A. fumigatus*, *A. flavus* and *F. udum*; and lower by *R. oryzae*, *C. echinulata*, *M. globosus*, *A. niger*, *A. luchuensis*, *A. nidulans*, *D. australiensis*, *D. hawaiiensis*, *C. pallescens*, *R. solani* and *S. rolfsii*. In the cultivar BDN-1, higher frequency value was noticed for *A. fumigatus* and *A. niger*; and lower for *Rhizopus nigricans*, *C. echinulata*, *C. bertholletiae*, *A. funiculosus*, *A. terreus*, *A. candidus*,

T. viride, T. album, E. udum, D. hawaiiensis, H. sativum, P. pullulans, R. solani, S. rolfsii and yellow sterile mycelium (Table 32).

A perusal of table 33 shows that the frequency of most of the fungi in the rhizosphere of uninoculated plants of both the cultivar T-21 and EDN-1, decreased with the application of 1500 ppm of fytolan after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Trichoderma viride, Drechslera australiensis, Curvularia pallescens and black sterile mycelium decreased after each spray; Chaetomium flavum after II and III spray; A. candidus, Penicillium chrysogenum, Gelasinospora cerealis and Eusidium viride after III spray. Rest of the fungi followed the similar pattern. In the cultivar EDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, A. fumigatus, A. flavus, A. niger, A. sydowi, C. curtipes, T. viride, D. australiensis, C. pallescens, Alternaria alternata and yellow sterile mycelium decreased after each spray; C. flavum, C. magnum, C. aspermum, T. lignorum and E. viride after III spray. Other fungi also followed a similar pattern. Higher frequency value in the rhizosphere of uninoculated plants of cultivar T-21, after 1500 ppm of fytolan spray, was noticed for A. fumigatus, and lower for R. oryzae, C. tenella, A. funiculosus, A. niger, A. luchuensis,

A. terreus, A. nidulans, A. sulphureus, A. candidus, C. flavum, C. magnum, P. chrysogenum, C. curtipes, C. roseo-griseum, C. aspermum, G. cerealis, T. viride, E. viride, D. australiensis, C. pallescens and black sterile mycelium. In the cultivar BDN-1 higher frequency value was recorded for A. fumigatus, A. niger and A. terricola; and lower for R. oryzae, R. nigricans, C. berthollatiae, S. racemosum, A. funiculosus, A. terreus, A. candidus, A. ustus, C. flavum, C. magnum, Cephalosporium roseo-griseum, C. aspermum, Trichoderma lignorum, E. viride, D. australiensis, C. pallescens and black sterile mycelium (Table 33). With the application of 1500 ppm of fytolan in the rhizosphere of inoculated plants of cultivar T-21 after I, II and III spray, the frequency of R. oryzae, Cunninghamella echinulata, Mucor globosus, A. fumigatus, A. funiculosus, A. ustus, A. terricola, Monosporium olivaceum and yellow sterile mycelium increased after each spray except R. oryzae, C. echinulata, A. fumigatus, A. funiculosus, A. terricola, M. olivaceum after I spray; A. ustus after I and II spray, where the frequency decreased. On the other hand, the frequency of Mortierella alpina, Aspergillus flavus, A. niger, A. terreus, A. candidus, Fusarium udum, D. australiensis, C. pallescens, Alternaria alternata and Helminthosporium sativum decreased after each spray except Alternaria alternata after I spray; A. candidus after III spray, where the frequency increased. The frequency of Fusarium oxysporum after I and II spray; C. flavum after II and III spray; C. magnum, Rhizoctonia solani after III spray decreased. In the cultivar BDN-1, the frequency of Rhizopus nigricans, Cunninghamella echinulata, C. bertholletiae, A. fumigatus, A. flavus, A. funiculosus, A. niger, A. ustus, A. sydowi and yellow sterile mycelium increased after each spray; however, the frequency of R. nigricans, C. echinulata, C. bertholletiae, A. funiculosus, A. niger, A. ustus, A. sydowi after I spray; A. fumigatus after I and II spray decreased. The frequency of Cephalosporium aspermum increased after III spray. On the other hand, the frequency of Mucor mucedo, Aspergillus candidus, M. olivaceum, T. viride, F. udum, D. australiensis, C. pallescens, A. alternata, H. sativum and Hormiscium stilbosporum decreased after each spray; A. terreus, A. terricola, F. oxysporum after I and II spray; C. flavum after II and III spray; C. magnum and R. solani after III spray. In the rhizosphere of inoculated plants of cultivar T-21 after 1500 ppm fytolan spray, higher frequency value was exhibited by A. fumigatus and F. udum; and lower by R. oryzae, M. globosus, M. racemosus, A. niger, A. candidus, C. flavum, M. olivaceum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, H. sativum, R. solani, Sclerotium rolfsii and yellow sterile mycelium. In the cultivar BDN-1, higher frequency value was noticed for A. fumigatus, A. flavus, A. niger; and lower for

R. nigricans, C. bertholletiae, M. mucedo, A. funiculosus, A. terreus, A. candidus, A. ustus, A. terricola, C. flavum, C. magnum, C. aspermum, M. olivaceum, E. udum, E. oxysporum, C. pallescens, A. alternata, H. sativum, H. stilbosporum, R. solani and yellow sterile mycelium (Table 33).

A perusal of table 34 indicates that the frequency of most of the fungi in the rhizoplane of uninoculated plants of both the cultivars T-21 and BDN-1 decreased with the application of 1500 ppm of fytolan after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Trichoderma viride, Pullularia pullulans and black sterile mycelium decreased after each spray; A. sulphureus after I and II spray; A. candidus, Curvularia pallescens after II and III spray; A. nidulans, Drechslera australiensis, Helminthosporium sativum, after III spray. A similar pattern was followed by rest of the forms. In the cultivar BDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, C. curtipes, T. viride, P. pullulans and black sterile mycelium decreased after each spray; D. australiensis, D. hawaiiensis after II and III spray; and H. sativum after III spray. Higher frequency value in the rhizosphere of uninoculated plants of cultivar T-21, after 1500 ppm of fytolan spray was shown by *A. fumigatus* and lower by *R. oryzae*, *C. tenella*, *A. funiculosus*, *A. niger*, *A. luchuensis*, *A. terreus*, *A. nidulans*, *A. sulphureus*, *A. candidus*, *C. curtipes*, *C. roseo-griseum*, *T. viride*, *T. album*, *C. pallescens*, *D. australiensis*, *H. sativum*, *P. pullulans* and black sterile mycelium. In the cultivar EDN-1, higher frequency value was recorded for *A. fumigatus*, *A. niger* and *C. curtipes*, and lower for *R. oryzae*, *R. nigricans*, *C. bertholletiae*, *S. racemosum*, *A. funiculosus*, *A. terreus*, *A. candidus*, *C. roseo-griseum*, *T. viride*, *T. album*, *C. pallescens*, *D. australiensis*, *D. hawaiiensis*, *H. sativum* and *P. pullulans* (Table 34). In the rhizoplane of inoculated plants of cultivar T-21 with the application of 1500 ppm of fytolan after I, II and III spray, the frequency of *R. oryzae*, *Cunninghamella echinulata*, *A. fumigatus*, *A. flavus*, *A. funiculosus*, *A. niger*, *A. luchuensis*, *A. nidulans* and *A. candidus* increased after each spray except *A. funiculosus*, *A. niger*, *A. luchuensis*, *A. candidus* after I spray; *A. fumigatus*, *A. flavus* after I and II spray; *A. nidulans* after II spray, where the frequency decreased. On the other hand, the frequency of *Mucor globosus*, *Fusarium udum*, *D. australiensis*, *P. pullulans*, and yellow sterile mycelium decreased after each spray; *C. pallescens*, *Sclerotium rolfsii* after II and III spray *H. sativum* after III spray. In the cultivar EDN-1 the frequency of *R. oryzae*, *R. nigricans*, *Mucor mucedo*, *A. fumigatus*, *A. flavus*, *A. niger*, *A. terreus*, *A. candidus*, *T. viride* and *T. album* increased after each spray except *R. nigricans*, *A. flavus*, *A. candidus*,

T. viride after I spray; A. niger after I and II spray, where the frequency decreased. On the other hand, the frequency of Cunninghamella echinulata, C. bertholletiae, Aspergillus funiculosus, Fusarium udum, P. pullulans and yellow sterile mycelium decreased after each spray except A. funiculosus after III spray, where the frequency increased. The frequency of C. pallescens, D. australiensis, D. hawaiiensis, Rhizoctonia solani, S. rolfsii after II and III spray; H. sativum after III spray decreased. Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21 after 1500 ppm of fytolan spray was noticed for A. fumigatus, A. flavus and F. udum; and lower for C. echinulata, M. globosus, A. funiculosus, A. niger, A. luchuensis, A. nidulans, A. candidus, C. pallescens, D. australiensis, D. hawaiiensis, P. pullulans, R. solani and S. rolfsii. In the cultivar BDN-1, higher frequency value was recorded for A. fumigatus and A. niger; and lower for R. oryzae, R. nigricans, C. echinulata, A. funiculosus, T. viride, T. album, F. udum, C. pallescens, D. australiensis, H. sativum, R. solani, S. rolfsii and yellow sterile mycelium (Table 34).

The frequency of most of the fungi decreased in the rhizosphere of uninoculated plants of cultivar T-21 and BDN-1 with the application of 1500 ppm of captan after I, II and III spray (Table 35). In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, *A. flavus*, *A. niger*, *Cephalosporium curtipes*, *Trichoderma viride*, *Drechslera australiensis*, *Curvularia pallescens* and black sterile mycelium decreased after each spray; *C. aspermum* after I spray; *A. candidus*, *Chaetomium flavum* after II and III spray; *C. magnum*, *Fusidium viride* after III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of *R. oryzae*, *Cunninghamella bertholletiae*, *Syncephalastrum racemosum*, *A. fumigatus*, *A. flavus*, *A. niger*, *C. curtipes*, *T. viride*, *D. australiensis*, *C. pallescens* and *Alternaria alternata* decreased after each spray; *T. lignorum* after II and III spray; *C. aspermum*, *F. viride* after III spray. Higher frequency value in the rhizosphere of uninoculated plants (T-21) after 1500 ppm of captan spray was shown by *A. fumigatus* and *A. flavus*; and lower by *R. oryzae*, *C. tenella*, *A. funiculosus*, *A. niger*, *A. luchuensis*, *A. terreus*, *A. nidulans*, *A. sulphureus*, *A. candidus*, *A. terricola*, *C. flavum*, *C. magnum*, *C. curtipes*, *C. roseo-griseum*, *C. aspermum*, *Gelasinospora cerealis*, *T. viride*, *F. viride*, *D. australiensis*, *C. pallescens* and black sterile mycelium. In the cultivar BDN-1, higher frequency value was recorded for *Aspergillus flavus* and *A. niger*; and lower for *R. oryzae*, *R. nigricans*, *C. bertholletiae*, *A. funiculosus*, *A. terreus*, *A. ustus*, *A. terricola*, *C. flavum*, *C. magnum*, *Penicillium chrysogenum*, *Cephalosporium roseo-griseum*, *C. aspermum*, *T. viride*, *T. lignorum*, *F. viride*, *D. australiensis*, *C. pallescens* and *A. alternata* (Table 35). In the rhizosphere of inoculated plants of cultivar T-21 with the application of 1500 ppm of captan after I, II and III spray, the frequency of R. oryzae, Cunninghamella echimulata, A. fumigatus, A. flavus, A. funiculosus, A. niger, A. candidus, C. pallescens, A. alternata, and Helminthosporium sativum increased after each spray except R. oryzae, C. echimulata, A. fumigatus, A. funiculosus, A. niger, A. candidus, C. pallescens, A. alternata after I spray, where the frequency decreased. On the other hand, the frequency of Mucor racemosus, Mortierella alpina, Aspergillus terreus, A. ustus, A. terricola, Monosporium olivaceum, Fusarium udum, F. oxysporum, D. australiensis, and yellow sterile mycelium decreased after each spray; Rhizoctonia solani, Sclerotium rolfsii after II and III spray; C. magnum after III spray. In the cultivar BDN-1, the frequency of Rhizopus nigricans, Cunninghamella echinulata, C. bertholletiae, Mucor mucedo, A. alternata, H. sativum, Hormiscium stilbosporum and yellow sterile mycelium increased after each spray except R. nigricans, C. bertholletiae, yellow sterile mycelium after I spray; C. echinulata after I and II spray, where the frequency decreased. The frequency of C. flavum, R. solani, S. rolfsii after II and III spray; C. magnum and C. curtinea after III spray increased. On the other hand, the frequency of A. fumigatus, A. flavus, A. niger, A. terreus, A. candidus, A. sydowi, M. olivaceum, T. viride, F. udum, F. oxysporum, D. australiensis and C. pallescens decreased after each spray; A. ustus, A. terricola after I and II spray. Higher frequency value in the rhizosphere of inoculated plants of cultivar T-21, after 1500 ppm of captan spray was exhibited by A. fumigatus and E. udum; and lower by R. oryzae, M. globosus, M. racemosus, M. alpina, A. funiculosus, A. candidus, A. ustus, A. terricola, C. flavum, C. magnum, M. olivaceum, F. oxysporum, C. pallescens, A. alternata, R. solani, S. rolfsii and yellow sterile mycelium. In the cultivar BDN-1 higher frequency value was noticed for A. fumigatus; and lower for R. nigricans, C. echinulata, C. bertholletiae, M. mucedo, A. terreus, A. candidus, A. ustus, A. terricola, A. sydowi, Cephalosporium aspermum, M. olivaceum, T. viride, F. udum, F. oxysporum, R. solani, S. rolfsii and yellow sterile mycelium (Table 35).

A perusal of table 36 indicates that in the rhizoplane of uninoculated plants of cultivars T-21 and BDN-1 with the application of 1500 ppm of captan after I, II and III spray, the frequency of most of the fungi decreased. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Trichoderma viride, Pullularia pullulans and black sterile mycelium decreased after each spray. A. candidus, Drechslera australiensis, after II and III spray; A. nidulans, Curvularia pallescens, Helminthosporium sativum after III spray. Other fungi followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum,

A. fumigatus, A. flavus, A. niger, A. terreus, C. curtipes, T. viride, P. pullulans and black sterile mycelium decreased after each spray; D. australiensis after II and III spray; D. hawaiiensis and H. sativum after III spray. A similar pattern was followed by rest of the fungi. Higher frequency value in the rhizoplane of uninoculated plants of cultivar T-21, after 1500 ppm of captan spray, was recorded for A. fumigatus; and lower for R. oryzae, C. tenella, A. funiculosus, A. niger, A. luchuensis, A. terreus, A. nidulans, A. sulphureus, A. candidus, C. curtipes, C. roseo-griseum, T. viride, T. album, D. australiensis, C. pallescens, H. sativum, P. pullulans and black sterile mycelium. In the cultivar BDN-1, higher frequency value was noticed for A. fumigatus, A. niger and C. curtipes; and lower for R. oryzae, R. nigricans, C. bertholletiae, S. racemosum, A. funiculosus, A. terreus, A. candidus, T. viride, T. album, D. australiensis, D. hawaiiensis, C. pallescens, H. sativum and P. pullulans (Table 36). In the rhizoplane of inoculated plants of cultivar T-21, with the application of 1500 ppm of captan after I, II and III spray, the frequency of R. oryzae, Cunninghamella echinulata, A. fumigatus, A. flavus, A. niger, A. candidus increased after each spray except R. oryzae, C. echinulata, A. fumigatus and A. candidus after I spray, where the frequency decreased. On the other hand, the frequency of Mucor globosus, Fusarium udum, D. australiensis and P. pullulans decreased after each spray; D. hawaiiensis, C. pallescens, Rhizoctonia solani and Sclerotium rolfsii after II and III spray; H. sativum after III spray. In the cultivar BDN-1, the frequency of Aspergillus niger and P. pullulans increased after each spray; D. australiensis, D. hawiiensis, C. pallescens, H. sativum R. solani and S. rolfsii after II and III spray. On the other hand, the frequency of Rhizopus nigricans, Cunninghamella echinulata, C. bertholletiae, Mucor mucedo, A. fumigatus, A. flavus, A. funiculosus, A. candidus, T. viride, T. album F. udum and yellow sterile mycelium decreased after each spray. Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21 after 1500 ppm of captan spray was shown by A. fumigatus, A. flavus and F. udum; and lower by R. oryzae, C. echinulata, M. globosus, A. nidulans, A. candidus, D. australiensis, D. hawaiiensis, C. pallescens, R. solani and yellow sterile mycelium. In the cultivar BDN-1, higher frequency value was recorded for Aspergillus niger, D. australiensis and P. pullulans; and lower for R. nigricans, C. echinulata, C. bertholletiae, A. funiculosus, A. terreus, A. candidus, T. viride, T. album, F. udum and yellow sterile mycelium (Table 36).

A perusal of table 37 indicates that, with the application of 1500 ppm of wettable sulphur after I, II and III spray, the frequency of most of the fungi decreased in the rhizosphere of uninoculated plants of both the cultivars T-21 and BDN-1. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Trichoderma viride, Drechslera australiensis and black sterile mycelium decreased after each spray; Chaetomium flavum, C. aspermum after II and III spray; C. magnum and Fusidium viride after III spray. Rest of the forms followed a similar pattern except A. terreus after I spray and Curvularia pallescens after II spray, where the frequency increased. In the cultivar BDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, C. curtipes, T. viride and black sterile mycelium decreased after each spray; F. viride after III spray. Rest of the fungi followed a similar pattern except D. australiensis, C. pallescens after II and III spray where the frequency increased. Higher frequency value in the rhizosphere of uninoculated plants of cultivar T-21, after 1500 ppm of wettable sulphur spray, was exhibited by A. fumigatus and A. flavus; and lower by R. oryzae, C. tenella, A. funiculosus, A. niger, A. luchuensis, A. terreus, A. nidulans, A. sulphureus, A. candidus, C. flavum, C. magnum, C. curtipes, C. roseo-griseum, C. aspermum, Gelasinospora cerealis, F. viride, D. australiensis and black sterile mycelium. In the cultivar BDN-1, higher frequency value was noticed for A. fumigatus, A. niger and C. curtipes; and lower for R. oryzae, R. nigricans, C. bertholletiae A. funiculosus, A. ustus, A. terricola, A. sydowi, C. flavum,

C. magnum, Penicillium chrysogenum, C. cerealis, Trichoderma lignorum, T. viride, D. australiensis, C. pallescens and Alternaria alternata (Table 37). In the rhizosphere of inoculated plants of cultivar T-21, with the application of 1500 ppm of wettable sulphur after I, II and III spray, the frequency of R. oryzae, Cunninghamella echinulata, Mucor globosus, A. fumigatus, A. flavus, A. niger, A. ustus, C. pallescens, A. alternata, H. sativum and yellow sterile mycelium increased after each spray except A. fumigatus, A. ustus, H. sativum, yellow sterile mycelium after I spray; A. niger after I and II spray, where the frequency decreased. On the other hand, the frequency of Mucor racemosus, Mortierella alpina, Aspergillus funiculosus, A. terreus, A. candidus, A. terricola, Fusarium udum and F. oxysporum decreased after each spray except A. funiculosus after I and II spray, where the frequency increased. The frequency of C. flavum, Rhizoctonia solani and Sclerotium rolfsii after II and III spray; C. magnum after III spray decreased. In the cultivar HDN-1, the frequency of Rhizopus nigricans, Aspergillus flavus, A. terreus, A. sydowi, Monosporium olivaceum, Fusarium oxysporum, D. australiensis, C. pallescens, A. alternata, H. sativum and yellow sterile mycelium increased after each spray except R. nigricans, A. flavus after I spray, where the frequency decreased. The frequency of C. flavum, R. solani and S. rolfsii after II and III spray increased. On the other hand, the frequency of C. echinulata, C. bertholletiae, Mucor mucedo, A. fumigatus, A. funiculosus,

A. candidus, A. terricola, T. viride and F. udum decreased after each spray except T. viride after I spray, where the frequency increased. Higher frequency value in the rhizosphere of inoculated plants of cultivar T-21, after 1500 ppm of wettable sulphur spray, was recorded for C. echinulata, A. fumigatus, A. flavus, F. udum and D. australiensis; and lower for M. globosus, M. racemosus, M. alpina, A. funiculosus, A. candidus, A. terricola, C. flavum, M. olivaceum, F. oxysporum, C. pallescens, A. alternata, R. solani, S. rolfsii and yellow sterile mycelium. In the cultivar BDN-1, higher frequency value was noticed for A. fumigatus, D. australiensis, C. pallescens; and lower for R. nigricans, C. echinulata, C. bertholletiae, M. mucedo, A. funiculosus, A. candidus, A. ustus, A. terricola, Cephalosporium aspermum, T. viride, H. sativum, R. solani and yellow sterile mycelium.

Table 38 indicates that in the rhizoplane of uninoculated plants of cultivar T-21 and BDN-1, with the application of 1500 ppm of wettable sulphur after I, II and III spray, the frequency of most of the fungi decreased. In the cultivar T-21, the frequency of Rhizopus oryzae, Cunninghamella bertholletiae, Aspergillus fumigatus, A. flavus, A. luchuensis, Cephalosporium curtipes, Trichoderma viride, Pullularia pullulans and black sterile mycelium decreased after each spray; Curvularia pallescens after II and III spray except A. luchuensis after I and II spray, where the frequency increased. The frequency of *Curvularia pallescens* decreased after II and III spray; *Drechslera australiensis* and *Helminthosporium sativum* after III spray. Rest of the fungi followed a similar pattern except *Aspergillus niger* and *Trichoderma album*, the frequency of *A. niger* increased after each spray and *T. album* decreased after I spray but did not show any change after II and III spray. In the cultivar BDN-1, the frequency of *R. oryzae*, *C. bertholletiae*, *A. fumigatus*, *A. flavus*, *A. niger*, *T. viride*, *P. pullulans* and black sterile mycelium decreased after each spray; *D. australiensis* after II and III spray; *D. hawaiiensis* after III spray. Other forms followed a similar pattern. Higher frequency value in the cultivar T-21 was recorded for *A. fumigatus*; and lower for *C. tenella*, *A. funiculosus*, *A. niger*, *A. luchuensis*, *A. nidulans*, *A. sulphureus*, *A. candidus*, *Cephalosporium roseo-griseum*, *T. viride*, *T. album*, *C. pallescens*, *D. australiensis*, *D. hawaiiensis* and *H. sativum* after 1500 ppm of wettable sulphur spray. In the cultivar BDN-1, higher frequency value was noticed for *A. fumigatus*, *A. niger*, *C. curtipes* and black sterile mycelium; and lower for *R. oryzae*, *R. nigricans*, *C. bertholletiae*, *Syncephalastrum racemosum*, *A. funiculosus*, *A. candidus*, *C. roseo-griseum*, *Trichoderma album*, *C. pallescens*, *D. australiensis*, *D. hawaiiensis*, *H. sativum* and *P. pullulans* (Table 38). In the rhizoplane of inoculated plants of cultivar

T-21 with the application of 1500 ppm of wettable sulphur after I, II and III spray, the frequency of R. oryzae, A. fumigatus, A. flavus, A. niger, A. candidus increased after each spray except R. oryzae, A. fumigatus, A. niger, and A. candidus after I spray, where the frequency decreased. The frequency of A. luchuensis after I spray; A. nidulans after II and III spray increased. On the other hand, the frequency of Mucor globosus, Cunninghamella echinulata, Fusarium udum, D. australiensis, D. hawaiiensis and P. pullulans decreased after each spray; C. pallescens, Rhizoctonia solani, Sclerotium rolfsii after II and III spray; H. sativum after III spray; however, the frequency of R. solani increased after II spray. In the cultivar BDN-1, the frequency of Mucor mucedo, Aspergillus funiculosus, A. flavus, A. niger and P. pullulans increased after each spray; C. pallescens, H. sativum, R. solani and S. rolfsii after II and III spray except S. rolfsii after III spray, where the frequency decreased. On the other hand, the frequency of Rhizopus nigricans, Cunninghamella echinulata, C. bertholletiae, A. fumigatus, A. terreus, A. candidus, Fusarium udum and black sterile mycelium decreased after each spray except R. nigricans after II spray, where the frequency increased. The frequency of Trichoderma album after I and II spray; D. australiensis and D. hawaiiensis after II and III spray decreased. Higher freuqnecy value in the rhizoplane of inoculated plants of cultivar T-21 was shown by A. fumigatus, A. flavus and

F. udum; and lower-R. oryzae, C. echinulata, M. globosus, A. funiculosus, A. niger, A. luchuensis, C. pallescens, A. nidulans, D. australiensis, D. hawaiiensis, Pullularia pullulans, R. solani and S. rolfsii. In the cultivar BDN-1, higher frequency value was recorded for Aspergillus niger and P. pullulans; and lower for R. nigricans, C. echinulata, C. bertholletiae, A. funiculosus, A. terrerus, A. candidus, T. viride, T. album, F. udum, and Drechslera hawaiiensis (Table 38).

Frequency of majority of the fungi decreased in the rhizosphere of uninoculated plants of cultivar T-21 and BDN-1, with the application of 100 ppm of 2,4-dichlorophenoxyacetic acid after I, II and III spray (Table 39). In the cultivar T-21, the frequency of Rhizopus oryzae, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Trichoderma viride, Drechslera australiensis, Curvularia pallescens and black sterile mycelium decreased after each spray; A. funiculosus after I spray; Circinella tenella after I and II spray; Chaetomium flavum after II and III spray; A. candidus, C. magnum, Gelasinospora cerealis, Fusidium viride after III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, C. curtipes, T. viride, Drechslera australiensis and Alternaria alternata decreased after each spray except A. alternata after II and III spray, where no change in the frequency occurred. The frequency of C. flavum, Cephalosporium asperum, T. lignorum, and E. viride decreased after III spray. Others followed a similar pattern. Lower frequency value in the cultivar T-21 after 100 ppm of 2,4-dichlorophenoxyacetic acid was recorded for majority of the fungi such as R. oryzae, C. tenella, A. flavus, A. funiculosus, A. niger, A. luchuensis, A. terreus, A. nidulans, A. sulphureus, A. candidus, A. terricola, C. flavum, C. magnum, C. curtipes, C. roseo-griseum, C. asperum, C. cerealis, T. viride, E. viride, D. australiensis, C. pallescens and black sterile mycelium. In the cultivar BDN-1, lower frequency value was noticed for fungi like - R. oryzae, R. nigricans, C. bertholletiae, S. racemosum, Aspergillus funiculosus, A. terreus, A. candidus, A. ustus, A. terricola, A. sydowi, C. flavum, Penicillium chrysogenum, C. curtipes, C. roseo-griseum, C. asperum, T. viride, T. lignorum, E. viride, D. australiensis, C. pallescens, and A. alternata (Table 39). In the rhizosphere of inoculated plants of cultivar T-21 and BDN-1, the frequency of most of the fungi decreased with the application of 100 ppm of 2,4-dichlorophenoxyacetic acid after I, II and III spray. In the cultivar T-21, the frequency of R. oryzae, Cunninghamella echinulata, Mortierella alpina, A. fumigatus, A. flavus, A. niger, Monosporium olivaceum, Fusarium udum, F. oxysporum, D. australiensis, C. pallescens,

A. alternata and Helminthosporium sativum decreased after each spray; A. funiculosus, A. candidus after I and II spray; C. flavum, Rhizoctonia solani, Sclerotium rolfsii after II and III spray; C. magnum after III spray. Rest of the forms followed a similar pattern. In the cultivar BDN-1, the frequency of C. echinulata, Mucor globosus, A. fumigatus, A. flavus, A. niger, M. olivaceum, T. viride, Fusarium oxysporum, D. australiensis, C. pallescens, A. alternata, and H. sativum decreased after each spray; however, the frequency of C. echinulata after I spray and C. bertholletiae after I and II spray did not change. The frequency of A. funiculosus after I spray; A. terreus, A. ustus, F. udum, yellow sterile mycelium after I and II spray; C. flavum, after II and III spray; C. magnum, Cephalosporium asperum, R. solani and S. rolfsii after III spray decreased. A similar pattern was observed by other fungi except Rhizopus nigricans after III spray, where the frequency increased. In the rhizosphere of inoculated plants of cultivar T-21, lower frequency value was noticed for R. oryzae, C. echinulata, M. globosus, M. racemosus, M. alpina, A. funiculosus, A. niger, A. terreus, A. nidulans, A. candidus, A. ustus, A. terricola, C. magnum, M. olivaceum, F. oxysporum, A. alternata, H. sativum, R. solani, S. rolfsii and yellow sterile mycelium. In the cultivar BDN-1, higher frequency value was shown by A. fumigatus; and lower by Rhizopus nigricans, C. echinulata, C. bertholletiae, Mucor *mucedo*, A. *flavus*, A. *funiculosus*, A. *terreus*, A. *candidus*, A. *ustus*, A. *terricola*, A. *sydowi*, C. *flavum*, C. *magnum*, C. *aspermum*, T. *viride*, T. *album*, F. *udum*, F. *oxysporum*, C. *pallescens*, A. *alternata*, H. *sativum*, *Hormiscium stilbosporum*, R. *solani* and yellow sterile mycelium (Table 39).

It is evident from table 40 that in the rhizoplane of uninoculated plants of both the cultivar T-21 and BDN-1, the frequency of most of the fungi decreased with the application of 100 ppm of 2,4-dichlorophenoxyacetic acid after I, II and III spray. In the cultivar T-21, the frequency of *Rhizopus oryzae*, *Circinella tenella*, *Aspergillus fumigatus*, A. *flavus*, A. *niger*, *Cephalosporium curtipes*, *Trichoderma viride*, *Pullularia pullulans* and black sterile mycelium decreased after each spray; A. *candidus*, *Curvularia pallescens* after II and III spray; A. *nidulans*, *Drechslera australiensis*, *Helminthosporium sativum* after III spray. Similar pattern was observed by other fungi. In the cultivar BDN-1, the frequency of R. *oryzae*, *Cunninghamella bertholletiae*, *Syncephalastrum racemosum*, A. *fumigatus*, A. *flavus*, A. *niger*, C. *curtipes*, T. *viride*, *Pullularia pullulans* and black sterile mycelium decreased after each spray; D. *australiensis* after II and III spray; C. *pallescens*, D. *hawaiiensis* and H. *sativum* after III spray decreased. Lower frequency value in the rhizoplane of uninoculated plants of cultivar T-21 after 100 ppm 2,4-dichlorophenoxyacetic acid was recorded for majority of the fungi such as - R. oryzae, C. tenella, Aspergillus funiculosus, A. niger, A. luchuensis, A. nidulans, A. sulphureus, A. candidus, C. curtipes, C. roseo-griseum, T. viride, T. album, C. pallescens, D. australiensis, H. sativum, and P. pullulans. In the cultivar BDN-1, higher frequency value was noticed for A. fumigatus, A. niger and C. curtipes; and lower for R. oryzae, R. nigricans, C. tenella, S. racemosum, A. flavus, A. funiculosus, A. terreus, A. candidus, C. roseo-griseum, T. viride, T. album, C. pallescens, D. australiensis, D. hawaiiensis, H. sativum and P. pullulans (Table 40). In the rhizoplane of inoculated plants of both the cultivars T-21 and BDN-1, the frequency of majority of the fungi decreased, with the application of 100 ppm of 2,4-dichlorophenoxyacetic acid after I, II and III spray. In the cultivar T-21, the frequency of R. oryzae, Mucor globosus, A. fumigatus, A. flavus, A. candidus, Fusarium udum, P. pullulans and yellow sterile mycelium decreased after each spray, however, no change in the frequency was observed in A. candidus after II and III spray and R. oryzae after III spray. The frequency of Cunninghamella echinulata, Aspergillus funiculosus, A. luchuensis, after I and II spray; A. nidulans, H. sativum after II spray; C. pallescens, Drechslera hawaiiensis, Rhizoctonia solani and Sclerotium rolfsii after II and III spray decreased. On the other hand, the frequency of Aspergillus niger increased after each spray. In the cultivar BDN-1, the frequency of Rhizopus nigricans,

C. echinulata, Mucor mucedo, A. fumigatus, A. candidus, T. viride, F. udum, P. pullulans and yellow sterile mycelium decreased after each spray except T. viride after III spray, where the frequency did not change. The frequency of Aspergillus flavus decreased after III spray but did not change after I and II spray. The frequency of Aspergillus funiculosus, Trichoderma album after I and II spray; C. pallescens, D. australiensis, D. hawaiiensis, R. solani, S. rolfsii after II and III spray; H. sativum after III spray decreased where as the frequency of A. funiculosus after II spray did not change. On the other hand, the frequency of C. bertholletiae and A. niger increased after each spray except A. niger after I and II spray, where the frequency decreased. Higher frequency value in the cultivar T-21 after 100 ppm of 2,4-dichlorophenoxyacetic acid spray was recorded for A. fumigatus and F. udum, and lower for R. oryzae, C. echinulata, M. globosus, A. funiculosus, A. luchuensis, A. nidulans, A. candidus, C. pallescens, D. australiensis, D. hawaiiensis, R. solani and S. rolfsii. In the cultivar BDN-1, higher frequency value was noticed for A. niger, and lower for Rhizopus nigricans, C. echinulata, C. bertholletiae, M. mucedo, Aspergillus funiculosus, A. terreus, A. candidus, T. viride, T. album, F. udum, C. pallescens, D. hawaiiensis, H. sativum and R. solani (Table 40).

A perusal of table 41 reveals that in the rhizosphere of uninoculated plants of cultivar T-21 and BDN-1, the frequency of majority of the fungi increased with the application of 100 ppm of streptomycin after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Trichoderma viride, Drechslera australiensis, Curvularia pallescens and black sterile mycelium increased after each spray; A. candidus, Chaetomium flavum after II and III spray; C. magnum, Gelasinospora cerealis, Fusidium viride after III spray. Rest of the forms followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, C. curtipes, T. viride, D. australiensis, C. pallescens, Alternaria alternata and black sterile mycelium increased after each spray; C. flavum after II and III spray; C. magnum, C. asperum, F. viride, after III spray. Other fungi followed a similar pattern. Higher frequency value in the rhizosphere of uninoculated plants of T-21 after 100 ppm of streptomycin spray was recorded for A. fumigatus, A. flavus, A. nidulans, A. terricola, C. curtipes and T. viride; and lower for A. funiculosus, A. luchuensis, A. terreus, A. candidus, C. flavum, C. asperum, G. cerealis and C. pallescens. In the cultivar

BDN-1, higher frequency value was noticed for C. racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, A. candidus, A. terricola, A. sydowi, Penicillium chrysogenum, C. curtipes, T. viride; and lower for C. flavum, C. magnum, C. aspermum, T. lignorum, D. australiensis and C. pallescens (Table 41). In the rhizosphere of inoculated plants of both the cultivars T-21 and BDN-1, with the application of 100 ppm of streptomycin after I, II and III spray, the frequency of majority of the fungi increased. In the cultivar T-21, the frequency of R. oryzae, Cunninghamella echinulata, Mortierella alpina, A. fumigatus, A. flavus, A. niger, Monosporium olivaceum, Fusarium udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, Helminthosporium sativum and yellow sterile mycelium increased after each spray; A. funiculosus after I and II spray; C. flavum, and Sclerotium rolfsii after II and III spray; C. magnum after III spray. Other fungi followed a similar pattern. In the cultivar BDN-1, the frequency of Rhizopus nigricans, C. echinulata, Mucor mucedo, A. fumigatus, A. flavus, A. niger, M. olivaceum, F. udum, F. oxysporum, D. australiensis, C. pallescens, A. alternata, H. sativum, Hormiscium stilbosporum and yellow sterile mycelium increased after each spray; A. funiculosus after I and II spray; C. flavum and S. rolfsii after II and III spray; C. magnum, Cephalosporium aspermum after III spray. Other fungi had a similar pattern. Higher frequency value in the rhizosphere of inoculated plants of T-21 after 100 ppm of streptomycin spray was noticed for A. fumigatus, C. magnum, F. udum and D. australiensis; and lower for R. oryzae, A. funiculosus, A. candidus, A. ustus, C. pallescens, Rhizoctonia solani, S. rolfsii and yellow sterile mycelium. In the cultivar BDN-1, higher frequency value was shown by A. fumigatus, A. niger, D. australiensis, C. pallescens; and lower by R. nigricans, C. echinulata, C. bertholletiae, A. funiculosus, A. terreus, A. candidus, A. ustus, A. terricola, A. sydowi, H. sativum, R. solani and S. rolfsii (Table 41).

A perusal of Table 42 reveals that the frequency of most of the fungi increased in the rhizoplane of uninoculated plants of both the cultivars T-21 and BDN-1, with the application of 100 ppm of streptomycin after I, II and III spray. In the cultivar T-21, the frequency of Rhizopus oryzae, Circinella tenella, Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, Trichoderma viride, Pullularia pullulans and black sterile mycelium increased after each spray; A. nidulans; A. candidus, Curvularia pallescens after II and III spray; A. terreus, Drechslera australiensis, Helminthosporium sativum after III spray. Rest of the fungi followed a similar pattern. In the cultivar BDN-1, the frequency of R. oryzae, Cunninghamella bertholletiae, Syncephalastrum racemosum, A. fumigatus, A. flavus, A. niger, A. terreus, C. curtipes, T. viride, P. pullulans and black sterile mycelium increased after each spray; C. pallescens, D. australiensis after II and III spray; D. hawaiiensis and H. sativum after III spray. A similar trend was shown by other fungi. Higher frequency value in the rhizoplane of uninoculated plants of cultivar T-21 was noticed for A. fumigatus, A. flavus and black sterile mycelium; and lower for A. terreus, A . nidulans, C. pallescens, D. australiensis, D. hawaiiensis. In the cultivar BDN-1, higher frequency value was recorded for Rhizopus nigricans, A. fumigatus, A. flavus, A. niger, A. terreus, A. candidus, C. curtipes, C. roseo-griseum, T. viride, and black sterile mycelium; and lower for C. pallescens, Drechslera hawaiiensis and H. sativum (Table 42). In the rhizoplane of inoculated plants of cultivars T-21 and BDN-1, with the application of 100 ppm of streptomycin after I, II and III spray, the frequency of most of the fungi increased. In the cultivar T-21, the frequency of R. oryzae, Cunninghamella echinulata, Mucor globosus, A. fumigatus, A. flavus, A. niger, Fusarium udum, D. australiensis, P. pullulans and yellow sterile mycelium increased after each spray; A. funiculosus, A. luchuensis after I spray; A. nidulans after II and III spray; C. pallescens, Rhizoctonia solani, Sclerotium rolfsii, H. sativum after III spray. A similar pattern was shown by other fungi. In the cultivar BDN-1, the frequency of R. nigricans, C. echinulata, Mucor mucedo, A. fumigatus, A. flavus, A. niger, T. viride, F. udum, P. pullulans and yellow sterile mycelium increased after each spray; A. funiculosus after I and II spray; C. pallescens, D. australiensis, D . hawaiiensis, H. sativum, R. solani and S. rolfsii after II and III spray. Higher frequency value in the rhizoplane of inoculated plants of cultivar T-21 was noticed for A. fumigatus, A. flavus, F. udum, H. sativum, P. pullulans and yellow sterile mycelium; and lower for R. oryzae, C. echinulata, A. niger, A. luchuensis, A. nidulans, A. candidus, and D. hawaiiensis. In the cultivar BDN-1, higher frequency value was recorded for A. fumigatus, A. niger, F. udum, D. australiensis, P. pullulans and yellow sterile mycelium; and lower for R. nigricans, C. echinulata, C. bertholletiae, A. funiculosus, A. terreus, A. candidus, T. viride and T. album (Table 42).

It is evident from the above results that by and large the application of bavistin, vitavax, brassicol, benlate, fytolan, captan, wettable sulphur and 2,4-dichlorophenoxyacetic acid showed inhibitory effect on the rhizosphere population of uninoculated and inoculated plants of both the cultivars T-21 and BDN-1; however, some what stimulatory effect with benlate, fytolan, captan and wettable sulphur after I spray in the uninoculated plants of BDN-1, with benlate after I spray in the inoculated plants of BDN-1, was noticed. On the other hand, streptomycin spray showed stimulatory effect in the uninoculated and inoculated plants of both the cultivars. The effect of spray of different chemicals was significant at 5% and 1% level. However, with streptomycin (at 1% level) after II and III spray in inoculated plants of T-21 was insignificant, with benlate (at 5% level and 1% level) and fytolan (at 1% level) after I spray in uninoculated plants of BDN-1, with benlate after I spray (at 5% and 1% level) in inoculated plants of BDN-1. In the rhizosphere and rhizoplane of uninoculated plants of both the cultivars T-21 and BDN-1, the frequency of majority of fungi decreased with the spray of bavistin, vitavax, brassicol, benlate, fytolan, captan, wettable sulphur and 2,4-dichlorophenoxyacetic acid; however, with wettable sulphur, the frequency of some of the parasitic forms increased, and with streptomycin majority of the fungi increased. On the other hand, in the rhizosphere and rhizoplane of inoculated plants of both the cultivars, the frequency of majority of saprophytic forms increased while most of the parasitic forms decreased with the spray of bavistin, vitavax, brassicol, benlate and fytolan. In the rhizoplane of T-21 only, a similar trend was noticed with captan and wettable sulphur spray. The frequency of majority of the saprophytic forms along with few parasitic forms increased while other parasitic forms decreased in the rhizosphere of T-21 with captan and wettable sulphur spray. On the other hand, the frequency of most of the parasitic forms along with some saprophytic forms increased while majority of saprophytic forms decreased in the rhizosphere and rhizoplane of BDN-1 with captan and wettable sulphur. The frequency of most of the fungi decreased with 2,4-dichlorophenoxyacetic acid spray; however, increased with streptomycin spray. The frequency of Fusarium udum decreased in all the treatments in the rhizosphere and rhizoplane of both the cultivars except with streptomycin spray, where the frequency increased. In the uninoculated plants, majority of the saprophytic forms had higher frequency in comparison to most of the parasitic forms, in the rhizosphere and rhizoplane, in all the treatments, Similarly, majority of of saprophytic fungi had higher frequency in comparison to most of the parasitic forms in the rhizosphere and rhizoplane of inoculated plants of both the cultivars with bavistin, vitavax, brassicol, benlate and fytolan spray. A similar trend was observed with captan, wettable sulphur spray only in cultivar T-21; and with 2,4-dichlorophenoxyacetic acid and streptomycin in BDN-1. However, in the cultivar T-21, the frequency of majority of parasitic forms was found higher in comparison to most of the saprophytic forms with 2,4-dichlorophenoxy acetic acid and streptomycin spray, and in the cultivar BDN-1 with captan and wettable sulphur spray.

TABLE 41. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with streptomycin.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	30	35	35	20	15	10	25	20	15	20	20	30	25	30	35	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	25	30	35	5	10	10	15	20	20
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	35	30	25	-	-	-	-	-	-	25	20	10	30	25	15
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	20	30	30	20	10	5	35	15	10
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	15	15	30	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	15	20	25
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	15	20	30	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	25	30	35	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	15	25	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	30	40	40	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	70	75	75	60	50	40	65	55	45	50	55	60	55	60	65	55	50	45	60	55	50
A. flavus Link	45	50	60	50	55	65	40	35	30	50	40	35	45	50	60	50	55	65	30	30	25	35	30	30
A. funiculosus G. Smith	10	10	10	15	20	20	20	10	-	25	15	-	15	20	20	20	30	30	10	5	-	20	15	-
A. niger van Tieghem	20	25	30	25	30	35	30	25	20	35	30	25	70	80	85	75	85	90	45	40	30	50	45	45
A. luchuensis Inui	10	15	10	15	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	15	20	20	30	30	30	35	40	35	30	40	45	35	45	50	15	10	5	25	15	10
A. nidulans (Eidam) Winter	30	30	35	35	35	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	20	20	25	25	30	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	10	15	20	10	5	25	15	10	25	30	35	30	35	40	20	15	15	25	20	20
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	35	30	20	20	25	25	25	30	30	10	5	5	15	10	10
A. terricola Marchal	30	35	40	35	40	45	35	30	15	40	35	25	30	40	50	35	45	55	15	10	5	25	15	10
A. sydowi (Bainier)& Sartory) Thom &	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	40	45	55	25	20	15	35	25	20
Chaetomium flavum Omvik	-	10	10	-	15	15	-	15	30	-	25	35	-	-	-	-	-	-	-	-	-	-	-	-
C. magnum Bainier	-	-	15	-	-	30	-	-	25	-	-	40	-	-	5	-	-	10	-	-	25	-	-	35
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	35	40	50	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	35	40	45	-	-	-	-	-	-	50	55	60	55	60	65	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	20	25	35	-	-	-	-	-	-	20	25	30	25	30	35	-	-	-	-	-	-
C. aspermum Marchal	10	10	10	15	15	15	-	-	-	-	-	-	-	-	10	-	-	20	-	-	10	-	-	30
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	15	20	30	-	-	-	-	-	-	10	15	20	20	25	30
Trichoderma viride Pers. ex Fr.	30	30	35	35	35	40	-	-	-	-	-	-	25	30	35	30	35	40	10	15	20	20	25	30
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	15	15	20	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	70	75	75	-	-	-	-	-	-	15	25	30	20	30	35
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	15	20	25	-	-	-	-	-	-	10	15	20	20	25	30
Fusidium viride Grove	-	-	10	-	-	25	-	-	-	-	-	-	-	-	15	-	-	30	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	15	30	30	20	30	40	25	35	45	10	10	10	15	20	20	20	30	40	25	35	45
Curvularia pallescens Boedijn	10	10	10	15	20	20	10	10	10	15	15	15	15	10	15	20	15	15	25	30	35	30	35	40
Alternaria alternata (Fr.)Keissler	-	-	-	-	-	-	10	10	10	15	20	25	10	10	10	15	20	25	15	20	25	20	25	30
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	15	20	30	-	-	-	-	-	-	10	10	15	15	20	20
Hormiscium stilbosporum (Corda) Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	20	25	35
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	10	20	-	-	-	-	-	-	-	5	10	-	10	20
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	15	20	-	-	-	-	-	-	-	5	10	-	15	20
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	15	20	20	-	-	-	-	-	-	10	10	10	20	25	30
Black sterile mycelium	10	15	20	20	25	30	-	-	-	-	-	-	20	25	30	25	30	35	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 40. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with 2,4-dichlorophenoxyacetic acid.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	15	10	10	20	15	10	15	10	10	10	15	30	10	10	15	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	20	10	15	10	10	10	5	5
Cunninghamella echinulata Thaxtor	-	-	-	-	-	-	10	10	10	5	5	-	-	-	-	-	-	-	20	15	15	15	10	10
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	5	10	15	10	10	5	10	15	15
Circinella tenella (Ling-Young) Zycha	20	25	30	15	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	10	10	15	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	5	10	15
Syncephalastrum racemosum (Cohn) Schroetor	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	10	15	20	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	50	40	35	60	55	50	45	40	40	50	60	60	45	40	40	50	45	40	45	40	35
A. Clavus Link	40	45	50	35	30	30	45	40	35	40	35	30	35	40	45	30	25	20	30	30	25	30	25	25
A. funiculosus G. Smith	20	25	30	15	10	10	30	-	-	25	10	-	15	20	20	15	10	10	25	15	-	20	15	-
A. niger van Tieghem	15	15	15	15	10	10	15	10	5	15	15	20	30	95	100	70	60	50	60	55	40	55	50	45
A. luchuensis Inui	10	10	15	5	5	10	15	-	-	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	-	-	-	-	-	-	-	-	-	20	35	40	15	10	10	15	10	5	10	5	-
A. nidulans (Eidam) Winter	-	5	10	-	-	5	-	10	5	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	5	5	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	10	5	15	10	5	10	10	5	30	35	40	25	20	15	20	15	15	15	15	10
Cephalosporium curtipes Saccardo	25	25	30	20	15	10	-	-	-	-	-	-	55	60	70	50	45	40	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	10	5	5	-	-	-	-	-	-	25	30	40	20	20	15	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	15	10	10	-	-	-	-	-	-	30	35	40	25	20	15	20	15	10	15	10	10
T. album Preuss	10	10	10	5	5	5	-	-	-	-	-	-	10	15	20	5	10	15	10	10	5	5	5	-
Fusarium udum Butler	-	-	-	-	-	-	70	80	85	60	50	45	-	-	-	-	-	-	20	30	40	15	10	5
Curvularia pallescens Boedijn	-	10	15	-	5	10	-	20	25	-	15	20	-	5	10	-	-	5	-	10	30	-	5	20
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	-	5	15	15	20	15	10	10	-	15	20	-	10	15	-	30	35	-	15	25
D. hawaiiensis Subram. & Jain ex M.B. Ellis	-	-	5	-	-	-	5	10	15	-	5	10	-	-	15	-	-	10	-	10	20	-	5	15
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	15	-	-	35	-	-	30	-	-	10	-	-	5	-	5	25	-	-	20
Pullularia pullulans (de Bary) Berkhout	15	20	25	10	15	15	20	25	30	15	20	25	10	15	20	5	10	10	15	30	40	10	25	35
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	5	10	-	-	-	-	-	-	-	10	20	-	10	15
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	5	10	-	-	-	-	-	-	-	10	30	-	10	25
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	15	20	35	-	-	-	-	-	-	15	20	35	10	20	30
Black sterile mycelium	30	35	35	25	30	30	-	-	-	-	-	-	40	45	50	35	30	25	-	-	-	-	-	-

*Number of spray.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

**Calculated on the basis of 20 replicates.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 39. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with 2,4-dichlorophenoxyacetic acid.

Fungi isolated	T - 21 UCP			T - 21 UP			T - 21 ICP			T - 21 IP			BDN - 1 UCP			BDN - 1 UP			BDN - 1 ICP			BDN - 1 IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	15	10	5	20	15	10	20	10	5	20	20	30	15	10	10	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	10	5	5	10	10	5	10	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	25	15	10	-	-	-	-	-	-	25	20	10	20	15	10
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	5	10	10	20	10	5	15	10	5
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	10	10	5
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	5	10	15	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	15	20	20	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn)Schroeter Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	15	15	20	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	50	40	30	50	50	40	55	50	35	50	55	60	40	35	30	55	50	45	50	45	40
A. flavus Link	45	50	60	30	25	20	40	35	30	35	30	25	45	50	60	35	35	25	30	30	25	25	25	20
A. funiculosus G. Smith	10	10	10	5	-	-	20	10	-	15	10	-	15	20	20	10	5	5	10	5	-	5	-	-
A. niger van Tieghem	20	25	30	10	10	5	30	25	20	25	20	15	70	80	85	50	45	30	45	40	30	40	35	25
A. luchuensis Inui	10	15	10	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	5	5	5	30	30	30	25	20	20	30	40	45	25	20	10	15	10	5	10	5	-
A. nidulans (Eidam) Winter	30	30	25	20	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	20	20	25	15	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	-	5	20	10	5	15	5	-	25	30	35	20	15	15	20	15	15	15	10	10
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	25	20	10	20	25	25	15	10	5	10	5	5	5	5	-
A. terricola Marchal	30	35	40	20	15	10	35	30	15	25	20	10	30	40	50	15	10	10	15	10	5	10	5	5
A. sydowi (Bainier & Sartory) Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	20	15	15	25	20	15	20	20	10
Chaetomium flavum Omvik	-	10	10	-	5	5	-	15	30	-	10	25	-	5	10	-	-	5	-	10	20	-	5	10
C. magnum Bainier	-	-	15	-	-	10	-	-	25	-	-	20	-	-	5	-	-	-	-	-	25	-	-	20
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	20	10	10	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	20	10	10	-	-	-	-	-	-	50	55	60	25	15	10	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	10	10	5	-	-	-	-	-	-	20	25	30	15	10	5	-	-	-	-	-	-
C. aspermum Marchal	10	10	10	10	5	5	-	-	-	-	-	-	-	-	10	-	-	5	-	-	10	-	-	5
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	5	10	10	-	-	-	-	-	-	10	15	20	5	10	15
Trichoderma viride Pers. ex Fr.	30	30	35	20	15	10	-	-	-	-	-	-	25	30	35	20	15	10	10	15	20	5	5	15
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	-	-	5	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	55	70	70	45	40	35	-	-	-	-	-	-	15	25	30	10	5	-
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	5	5	10	-	-	-	-	-	-	10	15	20	5	10	15
Fusidium viride Grove	-	-	10	-	-	5	-	-	-	-	-	-	-	-	15	-	-	10	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	5	10	10	20	30	40	15	20	35	10	10	10	5	5	5	20	30	40	15	20	25
Curvularia pallescens Boedijn	10	10	10	5	5	5	10	10	10	5	5	5	15	10	15	10	5	5	25	30	35	10	20	20
Alternaria alternata (Fr.) Keissler	-	-	-	-	-	-	10	10	10	10	5	5	10	10	10	5	10	10	15	20	25	10	15	15
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	5	10	15	-	-	-	-	-	-	10	10	15	5	5	10
Hormiscium stilbasporum (Corda) Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	5	15	15
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	-	5	-	-	-	-	-	-	-	5	10	-	-	5
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	5	5	-	-	-	-	-	-	-	5	10	-	-	5
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	5	5	10	-	-	-	-	-	-	10	10	10	5	5	-
Black sterile mycelium	10	15	20	5	10	15	-	-	-	-	-	-	20	25	30	15	20	25	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 38. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with wettable sulphur.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	15	20	25	20	15	10	15	20	20	10	15	30	10	10	15	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	20	15	15	15	10	10	15	15	10
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	10	5	5	-	-	-	-	-	-	20	15	15	15	10	10
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	5	10	15	10	10	15	5	15	10
Circinella tenella (Ling-Young) Zycha	20	25	30	25	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	10	15	20	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	10	15	25
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	10	15	20	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	50	55	55	60	55	50	50	55	55	50	60	60	55	50	45	50	45	40	40	30	35
A. flavus Link	40	45	50	40	35	35	45	40	35	50	45	55	35	40	45	35	35	30	30	30	25	20	25	30
A. funiculosus G. Smith	20	25	30	15	10	10	30	-	-	25	10	10	15	20	20	10	15	20	25	15	-	25	20	20
A. niger van Tieghem	15	15	15	15	20	20	15	10	5	10	15	20	80	85	100	75	70	65	60	55	40	60	55	55
A. luchuensis Inui	10	10	15	15	15	10	15	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	-	-	-	-	-	-	-	-	-	20	35	40	15	20	30	15	10	5	10	10	5
A. nidulans (Eidam) Winter	-	5	10	-	5	10	-	10	5	-	10	15	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	10	10	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	5	10	15	15	10	5	10	15	20	30	35	40	25	20	20	20	15	15	15	10	10
Cephalosporium curtipes Saccardo	25	25	30	20	20	25	-	-	-	-	-	-	55	60	70	50	45	45	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	10	10	15	-	-	-	-	-	-	25	30	40	25	20	20	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	15	10	10	-	-	-	-	-	-	30	35	40	25	30	30	20	15	10	20	15	10
T. album Preuss	10	10	10	5	10	10	-	-	-	-	-	-	10	15	20	5	10	15	10	10	5	5	5	-
Fusarium udum Butler	-	-	-	-	-	-	70	80	85	65	60	55	-	-	-	-	-	-	20	30	40	10	15	20
Curvularia pallescens Boedijn	-	10	15	-	5	10	-	20	25	-	20	20	-	5	10	-	5	10	-	10	30	-	15	35
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	-	5	15	15	20	15	15	15	-	15	20	-	10	15	-	30	35	-	20	30
D. hawaiiensis Subram. & Jain ex M.B. Ellis	-	-	5	-	-	5	5	10	15	5	10	10	-	-	15	-	-	10	-	10	20	-	5	15
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	15	-	-	35	-	-	30	-	-	10	-	-	10	-	5	25	-	10	35
Pullularia pullulans (de Bary) Berkhout	15	20	25	10	15	20	20	25	30	25	20	20	10	15	20	5	10	15	15	30	40	20	30	40
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	15	15	-	-	-	-	-	-	-	10	20	-	15	25
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	15	15	-	-	-	-	-	-	-	10	30	-	20	25
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	10	20	30	-	-	-	-	-	-	15	20	35	10	15	25
Black sterile mycelium	30	35	35	25	30	30	-	-	-	-	-	-	40	45	50	30	35	40	-	-	-	-	-	-

*Number of spray.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

**Calculated on the basis of 20 replicates.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 37. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with wettable sulphur.

Fungi isolated	T- 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	25	25	20	20	15	10	20	25	25	20	20	30	20	20	15	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	20	15	15	15	10	10	10	15	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	35	40	40	-	-	-	-	-	-	25	20	10	20	10	10
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	15	10	10	20	10	5	15	15	10
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	10	15	20	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	10	10	5
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	5	10	15	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	15	20	20	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	10	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	20	20	25	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	55	50	50	60	50	40	50	55	55	50	55	60	50	50	45	55	50	45	40	45	45
A. flavus Link	45	50	60	45	45	40	40	35	30	40	45	45	45	50	60	45	30	35	30	30	25	25	30	35
A. funiculosus G. Smith	10	10	10	10	10	5	20	10	-	20	10	5	15	20	20	25	20	20	10	5	-	15	10	5
A. niger van Tieghem	20	25	30	20	15	15	30	25	20	15	20	25	70	80	85	60	40	45	45	40	30	35	30	25
A. luchuensis Inui	10	15	10	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	15	10	10	30	30	30	20	25	30	30	40	45	25	30	35	15	10	5	15	20	25
A. nidulans (Eidam) Winter	30	30	35	25	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	20	20	25	20	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	5	10	20	10	5	15	15	10	25	30	35	15	20	25	20	15	15	15	10	10
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	25	30	35	20	25	25	20	20	15	10	5	5	10	5	5
A. terricola Marchal	30	35	40	30	30	25	35	30	15	25	20	15	30	40	50	30	35	20	15	10	5	10	10	5
A. sydowi (Bainier & Sartory) Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	25	15	15	25	20	15	25	30	30
Chaetomium flavum Omvik	-	10	10	-	5	5	-	15	30	-	20	15	-	5	10	-	5	10	-	10	20	-	20	25
C. magnum Bainier	-	-	15	-	-	10	-	-	25	-	-	25	-	-	5	-	-	5	-	-	25	-	-	25
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	20	20	15	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	20	20	15	-	-	-	-	-	-	50	55	60	50	45	45	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	15	15	15	-	-	-	-	-	-	20	25	30	20	25	25	-	-	-	-	-	-
C. aspermum Marchal	10	10	10	-	5	10	-	-	-	-	-	-	-	-	10	-	-	10	-	-	10	-	-	10
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	10	10	10	-	-	-	-	-	-	10	15	20	15	20	25
Trichoderma viride Pers. ex Fr.	30	30	35	25	25	25	-	-	-	-	-	-	25	30	35	20	25	30	10	15	20	15	10	5
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	5	5	10	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	65	60	60	-	-	-	-	-	-	15	25	30	15	20	25
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	10	5	5	-	-	-	-	-	-	10	15	20	10	20	25
Fusidium viride Grove	-	-	10	-	-	5	-	-	-	-	-	-	-	-	15	-	-	10	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	10	10	10	20	30	40	20	35	45	10	10	10	10	15	20	20	30	40	25	35	45
Curvularia pallescens Boedijn	10	10	10	10	15	10	10	10	10	10	15	15	15	10	15	15	20	20	25	30	35	30	35	40
Alternaria alternata (Fr.) Keissler	-	-	-	-	-	-	10	10	10	10	15	20	10	10	10	10	10	10	15	20	25	20	25	30
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	5	15	25	-	-	-	-	-	-	10	10	15	15	15	20
Hormiscium stilbosporum (Corda) Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	15	20	25
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	5	10	-	-	-	-	-	-	-	5	10	-	10	15
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	10	15	-	-	-	-	-	-	-	5	10	-	20	25
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	5	10	15	-	-	-	-	-	-	10	10	10	10	15	20
Black sterile mycelium	10	15	20	15	10	10	-	-	-	-	-	-	20	25	35	15	20	25	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 36. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with captan.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	15	10	10	20	15	10	15	15	15	10	15	30	10	10	15	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	20	15	15	15	10	10	15	10	5
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	5	10	15	-	-	-	-	-	-	20	15	15	15	10	10
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	5	10	15	10	10	15	5	10	10
Circinella tenella (Ling-Young) Zycha	20	25	30	25	20	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	5	10	15	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	10	15	15
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	10	15	20	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	50	40	45	60	55	50	55	60	60	50	60	60	50	40	40	50	45	40	40	30	25
A. flavus Link	40	45	50	35	35	30	45	40	35	45	50	50	35	40	45	35	30	30	30	30	25	30	25	25
A. funiculosus G. Smith	20	25	30	20	15	15	30	-	-	-	-	-	15	20	20	15	15	15	25	15	-	15	10	5
A. niger van Tieghem	15	15	15	15	10	10	15	10	5	20	25	30	80	85	100	70	65	65	60	55	40	65	50	45
A. luchuensis Inui	10	10	15	5	5	10	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	-	-	5	-	-	-	-	-	-	20	35	40	20	15	15	15	10	5	15	10	5
A. nidulans (Eidam) Winter	-	5	10	-	-	5	-	10	5	-	5	10	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	5	5	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	10	5	15	10	5	10	15	20	30	35	40	25	20	20	20	15	15	15	15	10
Cephalosporium curtipes Saccardo	25	25	30	20	15	15	-	-	-	-	-	-	55	60	70	55	55	50	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	10	10	5	-	-	-	-	-	-	25	30	40	20	25	25	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	20	15	15	-	-	-	-	-	-	30	35	40	20	10	5	20	15	10	15	10	10
T. album Preuss	10	10	10	5	5	5	-	-	-	-	-	-	10	15	20	5	10	15	10	10	5	10	5	5
Fusarium udum Butler	-	-	-	-	-	-	70	80	85	65	55	50	-	-	-	-	-	-	20	30	40	10	15	20
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	10	5	15	15	20	10	10	15	-	15	20	-	10	15	-	30	35	-	35	40
D. hawaiiensis Subram. & Jain ex M.B. Ellis	-	-	5	-	-	-	5	10	15	-	10	5	-	-	15	-	-	10	-	10	20	-	15	25
Curvularia pallescens Boedijn	-	10	15	-	-	10	-	20	25	-	15	10	-	5	10	-	-	10	-	10	30	-	15	35
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	15	-	-	35	-	-	30	-	-	10	-	-	5	-	5	25	-	5	30
Pullularia pullulans (de Bary) Berkhout	15	20	25	10	10	15	20	25	30	20	15	15	10	15	20	5	10	15	15	30	40	20	35	45
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	10	10	-	-	-	-	-	-	-	10	20	-	15	25
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	15	15	-	-	-	-	-	-	-	10	30	-	15	35
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	15	20	20	-	-	-	-	-	-	15	20	25	10	15	20
Black sterile mycelium	30	35	35	20	15	15	-	-	-	-	-	-	40	45	50	35	30	25	-	-	-	-	-	-

*Number of spray.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

**Calculated on the basis of 20 replicates.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 35. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with captan.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	25	25	20	20	15	10	15	15	20	20	20	30	20	15	15	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	10	10	15	10	10	10	15	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	20	25	25	-	-	-	-	-	-	25	20	10	10	10	15
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	10	10	5	20	10	5	5	10	15
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	10	10	15	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	10	15	20
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	5	10	15	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	20	15	15	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	10	15	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	20	20	25	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	60	60	55	60	50	40	55	55	60	50	55	60	40	30	25	55	50	45	55	50	45
A. flavus Link	45	50	60	40	40	40	40	35	30	30	35	35	45	50	60	40	45	50	30	30	25	30	25	25
A. funiculosus G. Smith	10	10	10	10	10	5	20	10	-	5	15	20	15	20	20	10	15	15	10	5	-	10	-	-
A. niger van Tieghem	20	25	30	15	20	20	30	25	20	20	25	25	70	80	85	60	65	65	45	40	30	35	30	30
A. luchuensis Inui	10	15	10	10	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	10	5	10	30	30	30	20	25	25	30	40	45	25	20	20	15	10	5	10	5	5
A. nidulans (Eidam) Winter	30	30	35	25	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius)Thom & Church	20	20	25	15	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	5	5	20	10	5	15	20	20	25	30	35	-	-	-	20	15	15	15	15	10
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	20	15	15	20	25	25	20	15	15	10	5	5	5	5	-
A. terricola Marchal	30	35	40	25	20	20	35	30	15	20	20	15	30	40	45	25	25	20	15	10	5	10	10	-
A. sydowi (Bainier & Sartory)Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	30	30	30	25	20	15	15	15	10
Chaetomium flavum Omvik	-	10	10	-	10	5	-	15	30	-	10	5	-	5	10	-	5	10	-	10	20	-	15	25
C. magnum Bainier	-	-	15	-	-	10	-	-	25	-	-	20	-	-	5	-	-	5	-	-	25	-	-	30
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	25	20	20	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	25	20	15	-	-	-	-	-	-	50	55	60	45	40	30	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	10	10	5	-	-	-	-	-	-	20	25	30	15	20	20	-	-	-	-	-	-
C. asperum Marchal	10	10	10	5	-	-	-	-	-	-	-	-	-	-	10	-	-	5	-	-	10	-	-	15
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	5	5	10	-	-	-	-	-	-	10	15	20	15	10	10
Trichoderma viride Pers. ex Fr.	30	30	35	20	20	15	-	-	-	-	-	-	25	30	35	20	15	15	10	15	20	10	5	5
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	-	5	5	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	60	55	50	-	-	-	-	-	-	15	25	30	10	15	20
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	5	10	15	-	-	-	-	-	-	10	15	20	10	10	15
Fusidium viride Grove	-	-	10	-	-	5	-	-	-	-	-	-	-	-	15	-	-	10	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	10	10	10	20	30	40	15	25	35	10	10	10	5	5	5	20	30	40	20	25	30
Curvularia pallescens Boedijn	10	10	10	5	5	5	10	10	10	5	10	15	15	10	15	10	5	10	25	30	35	15	20	30
Alternaria alternata (Fr.) Keissler	-	-	-	-	-	-	10	10	10	5	15	20	10	10	10	5	5	5	15	20	25	15	25	30
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	10	20	30	-	-	-	-	-	-	10	10	15	15	20	25
Hormiscium stilbosporum(Corda) Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	20	25	30
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	10	15	-	-	-	-	-	-	-	5	10	-	10	15
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	10	20	-	-	-	-	-	-	-	5	10	-	15	20
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	15	10	10	-	-	-	-	-	-	10	10	10	5	10	15
Black sterile mycelium	10	15	20	15	10	10	-	-	-	-	-	-	20	25	30	-	-	-	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants

IP = Inoculated plants

TABLE 34. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with fytolan.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	15	20	15	20	15	10	20	25	25	10	15	30	10	10	5	-	-	-	10	15	20
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	15	10	15	10	10	10	10	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	10	15	20	-	-	-	-	-	-	20	15	15	20	10	10
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	10	10	10	10	10	5	5	5	5
Circinella tenella (Ling-Young) Zycha	20	25	30	20	15	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	5	10	15	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	25
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	10	15	20	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	55	50	50	60	55	50	45	50	55	50	60	60	50	45	45	50	45	40	50	60	60
A. flavus Link	40	45	50	35	35	30	45	40	35	30	35	45	35	40	45	35	30	30	30	30	25	25	30	30
A. funiculosus G. Smith	20	25	30	20	15	15	30	-	-	5	10	15	15	20	20	15	10	10	25	15	-	15	10	5
A. niger van Tieghem	15	15	15	15	10	10	15	10	5	10	15	20	80	85	100	70	65	65	60	55	40	35	40	45
A. luchuensis Inui	10	10	15	5	5	5	15	-	-	5	10	15	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	-	-	5	-	-	-	-	-	-	20	35	40	20	15	15	15	10	5	20	25	30
A. nidulans (Eidam) Winter	-	5	10	-	-	5	-	10	5	5	5	10	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	10	10	15	10	5	10	15	20	30	35	40	25	20	20	20	15	15	15	20	25
Cephalosporium curtipes Saccardo	25	25	30	20	20	15	-	-	-	-	-	-	55	60	70	50	45	45	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	10	5	5	-	-	-	-	-	-	25	30	40	25	20	15	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	20	15	15	-	-	-	-	-	-	30	35	40	25	25	15	20	15	10	15	20	20
T. album Preuss	10	10	10	5	5	5	-	-	-	-	-	-	10	15	20	5	10	15	10	10	5	10	10	15
Fusarium udum Butler	-	-	-	-	-	-	70	90	85	55	50	45	-	-	-	-	-	-	20	30	40	15	10	10
Curvularia pallescens Boedijn	-	10	15	-	10	10	-	20	25	-	15	10	-	5	10	-	5	10	-	10	30	-	10	20
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	-	5	15	15	20	10	10	5	-	15	20	-	10	15	-	30	35	-	15	20
D. hawaiiensis Subram.& Jain M.B. Ellis	-	-	5	-	-	-	5	10	15	-	5	10	-	-	15	-	5	10	-	10	20	-	5	10
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	15	-	-	35	-	-	30	-	-	10	-	-	5	-	5	25	-	-	15
Pullularia pullulans (de Bary) Berkhout	15	20	25	10	15	20	20	25	30	25	20	15	10	15	20	5	10	15	15	30	40	10	20	25
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	5	10	-	-	-	-	-	-	-	10	20	-	5	15
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	10	5	-	-	-	-	-	-	-	10	30	-	5	20
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	10	20	30	-	-	-	-	-	-	15	20	35	10	15	20
Black sterile mycelium	30	35	35	20	15	15	-	-	-	-	-	-	40	45	50	35	30	30	-	-	-	-	-	-

*Number of spray

UCP = Uninoculated control plants.

**Calculated on the basis of 20 replicates.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 33. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with fytolan.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	20	20	15	10	15	10	15	20	20	20	20	30	20	15	10	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	20	15	15	10	15	10	10	10	15	20
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	25	20	25	30	30	-	-	-	-	-	-	25	20	10	20	25	25
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	10	5	5	20	10	5	15	20	20
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	10	10	20	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	5	10	10
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	5	10	15	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	10	25	30	15	20	25	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	10	15	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	25	25	20	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	55	50	50	[illegible]	50	40	40	50	60	50	55	60	45	40	50	55	50	45	40	45	50
A. flavus Link	45	[illegible]	60	40	35	35	[illegible]	35	30	20	25	30	45	40	60	40	35	30	30	30	25	30	35	40
A. funiculosus G. Smith	10	10	10	10	5	5	[illegible]	10	-	15	20	25	15	20	20	15	10	10	10	5	-	5	10	15
A. niger van Tieghem	20	25	30	15	15	10	10	25	20	15	20	20	70	80	85	65	60	60	45	40	30	25	35	45
A. luchuensis Inui	10	15	10	10	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	5	5	5	10	30	30	20	25	25	30	40	45	25	25	20	15	10	5	10	5	-
A. nidulans (Eidam) Winter	30	30	35	25	20	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius)Thom & Church	20	20	25	20	15	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	-	5	[illegible]	10	5	15	10	10	25	30	35	20	20	15	20	15	15	15	10	10
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	10	25	20	15	20	25	20	25	25	15	15	10	10	5	5	5	5	10
A. terricola Marchal	30	35	40	25	30	35	15	30	15	25	30	30	30	40	50	25	30	40	15	10	5	10	5	-
A. sydowi (Bainier & Sartory)Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	30	25	25	25	20	15	20	20	25
Chaetomium flavum Omvik	-	10	10	-	5	5	-	15	30	-	10	25	-	5	10	-	-	5	-	10	20	-	10	15
C. magnum Bainier	-	-	15	-	-	10	-	-	25	-	-	20	-	-	5	-	-	5	-	-	25	-	-	20
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	25	30	35	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	25	25	20	-	-	-	-	-	-	50	55	60	40	35	30	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	10	5	5	-	-	-	-	-	-	20	25	30	15	15	10	-	-	-	-	-	-
C. asperum Marchal	10	10	10	5	5	5	-	-	-	-	-	-	-	-	10	-	-	5	-	-	10	-	-	15
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	0	10	10	5	10	15	-	-	-	-	-	-	10	15	20	5	10	15
Trichoderma viride Pers. ex Fr.	30	30	35	25	20	20	-	-	-	-	-	-	25	30	35	20	25	30	10	15	20	10	15	15
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	-	-	5	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	5	70	70	60	50	45	-	-	-	-	-	-	15	25	30	15	10	5
F. oxysporum Schlecht	-	-	-	-	-	-	0	10	20	5	5	-	-	-	-	-	-	-	10	15	20	5	5	-
Fusidium viride Grove	-	-	10	-	-	5	-	-	-	-	-	-	-	-	15	-	-	10	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	10	10	5	[illegible]	30	40	15	20	20	10	10	10	10	5	5	20	30	40	15	20	30
Curvularia pallescens Boedijn	10	10	10	10	5	5	0	10	10	10	5	5	15	10	15	10	10	10	25	30	35	20	10	10
Alternaria alternata (Fr.) Keissler	-	-	-	-	-	-	0	10	10	15	10	5	10	10	10	5	5	5	15	20	25	15	10	5
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	0	15	20	10	10	5	-	-	-	-	-	-	10	10	15	10	10	5
Hormiscium stilbosporum (Corda) Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	15	10	10
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	-	5	-	-	-	-	-	-	-	5	10	-	-	5
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	-	10	-	-	-	-	-	-	-	5	10	-	-	-
Yellow sterile mycelium	-	-	-	-	-	-	0	10	10	10	15	20	-	-	-	-	-	-	10	10	10	10	15	20
Black sterile mycelium	10	15	20	5	10	15	-	-	-	-	-	-	20	25	35	15	20	25	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP - Uninoculated control plants.

UP - Uninoculated plants.

ICP - Inoculated control plants.

IP - Inoculated plants.

TABLE 32. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with benlate.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	15	20	25	20	15	10	15	15	10	10	15	30	10	10	5	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	20	20	25	15	10	10	10	15	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	5	5	5	-	-	-	-	-	-	20	15	15	15	10	10
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	5	10	15	10	10	15	5	5	10
Circinella tenella (Ling-Young) Zycha	20	25	30	15	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	10	10	15	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	25
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	15	15	20	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	55	50	50	60	55	50	55	60	65	50	60	60	45	40	40	50	45	40	35	40	45
A. flavus Link	40	45	50	40	35	30	45	40	35	40	45	50	35	40	45	30	30	25	30	30	25	20	25	35
A. funiculosus G. Smith	20	25	30	20	20	15	30	-	-	25	-	-	15	20	20	10	15	15	25	15	-	-	10	20
A. niger van Tieghem	15	15	15	10	10	10	15	10	5	15	20	20	80	85	100	75	70	70	60	55	40	40	60	60
A. luchuensis Inui	10	10	15	10	5	5	15	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	-	-	-	-	-	-	-	-	-	20	35	40	15	20	35	15	10	5	10	15	20
A. nidulans (Eidam) Winter	-	5	10	-	5	5	-	10	5	-	5	10	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	10	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	5	10	15	10	5	15	20	25	30	35	40	25	20	20	20	15	15	15	10	10
Cephalosporium curtipes Saccardo	25	25	30	20	20	15	-	-	-	-	-	-	55	60	70	50	45	45	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	10	5	-	-	-	-	-	-	-	25	30	40	20	20	15	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	15	10	10	-	-	-	-	-	-	30	35	40	25	25	25	20	15	10	15	20	20
T. album Preuss	10	10	10	5	5	5	-	-	-	-	-	-	10	15	20	5	10	15	10	10	5	5	10	10
Fusarium udum Butler	-	-	-	-	-	-	70	80	85	60	50	40	-	-	-	-	-	-	20	30	40	15	10	10
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	-	10	15	15	20	15	10	10	-	15	20	-	10	15	-	30	35	-	20	30
D. hawaiiensis Subram. & Jain ex M.B. Ellis	-	-	5	-	-	5	5	10	15	-	5	10	-	-	15	-	-	10	-	10	20	-	5	15
Curvularia pallescens Boedijn	-	10	15	-	5	10	-	20	25	-	15	20	-	5	10	-	-	5	-	10	30	-	10	30
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	15	-	-	35	-	-	30	-	-	10	-	-	10	-	5	25	-	5	20
Pullularia pullulans (de Bary) Berkhout	15	20	25	10	15	15	20	25	30	15	20	25	10	15	20	10	10	15	15	30	40	10	15	20
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	5	10	-	-	-	-	-	-	-	10	20	-	5	15
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	10	15	-	-	-	-	-	-	-	10	30	-	5	10
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	15	25	35	-	-	-	-	-	-	15	20	25	10	15	20
Black sterile mycelium	30	35	35	20	20	25	-	-	-	-	-	-	40	45	50	30	30	45	-	-	-	-	-	-

*Number of spray.
UCP = Uninoculated control plants.
UP = Uninoculated plants.

**Calculated on the basis of 20 replicates.
ICP = Inoculated control plants.
IP = Inoculated plants.

TABLE 31. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with F. udum, sprayed with benlate.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	25	20	20	20	15	10	20	10	10	20	20	30	20	15	15	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	15	10	15	10	10	15	20	20
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	25	20	15	-	-	-	-	-	-	25	20	10	25	30	30
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	5	10	10	20	10	5	15	20	25
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	15	10	10	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne)Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	10	15	20
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	10	10	10	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	15	20	20	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum(Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	25	25	20	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	55	50	45	60	50	40	55	45	30	50	55	60	45	40	40	55	50	45	45	50	55
A. flavus Link	45	50	60	40	40	35	40	35	30	35	40	45	45	50	60	40	40	35	30	30	25	35	40	45
A. funiculosus G. Smith	10	10	10	10	10	5	20	10	-	10	15	20	15	20	20	10	10	5	10	5	-	15	10	5
A. niger van Tieghem	20	25	30	20	20	15	30	25	20	20	20	15	70	80	85	65	60	60	45	40	30	50	45	35
A. luchuensis Inui	10	15	10	10	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	10	10	5	30	30	30	30	35	35	30	40	45	25	20	10	15	10	5	10	15	20
A. nidulans (Eidam) Winter	30	30	35	25	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius)Thom & Church	20	20	25	15	15	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	5	5	20	10	5	5	10	15	25	30	35	20	15	10	20	15	15	10	20	20
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	30	20	20	20	25	25	15	10	10	10	5	5	10	15	15
A. terricola Marchal	30	35	40	25	20	15	35	30	15	20	25	25	30	40	50	25	20	15	15	10	5	10	20	25
A. sydowi (Bainier & Sartory)Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	30	35	20	25	20	15	20	20	30
Chaetomium flavum Omvik	-	10	10	-	5	5	-	15	30	-	10	20	-	5	10	-	5	10	-	10	20	-	5	15
C. magnum Bainier	-	-	15	-	-	10	-	-	25	-	-	20	-	-	5	-	-	5	-	-	25	-	-	10
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	25	20	20	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	25	20	20	-	-	-	-	-	-	50	55	60	45	40	35	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	15	10	10	-	-	-	-	-	-	20	25	30	20	20	15	-	-	-	-	-	-
C. aspermum Marchal	10	10	10	5	5	5	-	-	-	-	-	-	-	-	10	-	-	5	-	-	10	5	10	15
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	10	5	5	-	-	-	-	-	-	10	15	20	10	10	25
Trichoderma viride Pers.ex Fr.	30	30	35	25	20	20	-	-	-	-	-	-	25	30	35	20	25	25	10	15	20	10	20	30
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	-	5	5	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	60	50	45	-	-	-	-	-	-	15	25	30	15	10	10
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	5	5	-	-	-	-	-	-	-	10	15	20	5	5	-
Fusidium viride Grove	-	-	10	-	-	10	-	-	-	-	-	-	-	-	15	-	-	10	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	5	10	10	20	30	40	15	10	10	10	10	10	5	5	-	20	30	40	20	15	15
Curvularia pallescens Boedijn	10	10	10	10	5	5	10	10	10	5	5	-	15	10	15	10	5	-	25	30	35	25	20	10
Alternaria alternata (Fr.) Keissler	-	-	-	-	-	-	10	10	10	10	5	10	10	10	10	10	10	10	15	20	25	10	10	5
Helminthosporium sativum (Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	10	10	15	-	-	-	-	-	-	10	10	15	10	10	15
Hormiscium stilbosporum (Corda)Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	15	20	25
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	5	5	-	-	-	-	-	-	-	5	10	-	5	5
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	5	10	-	-	-	-	-	-	-	5	10	-	5	5
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	5	10	15	-	-	-	-	-	-	10	10	10	10	15	20
Black sterile mycelium	10	15	20	5	5	10	-	-	-	-	-	-	20	25	30	15	20	25	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP - Inoculated control plants.

IP - Inoculated plants.

TABLE 30. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with F. *udum*, sprayed with brassicol.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	10	10	5	20	15	10	15	20	20	10	15	30	10	10	5	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	20	20	15	10	10	15	20	25
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	10	15	15	-	-	-	-	-	-	20	15	15	25	20	20
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	5	10	15	10	10	5	5	5	10
Circinella tenella (Ling-Young) Zycha	20	25	30	15	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	10	15	25	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	10	20	25
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	15	15	10	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	50	40	35	60	55	50	60	65	65	50	60	60	45	40	40	50	45	40	55	60	60
A. flavus Link	40	45	50	30	30	25	45	40	35	40	45	50	35	40	45	30	30	30	30	30	25	30	35	35
A. funiculosus G. Smith	20	25	30	15	15	10	30	-	-	25	20	15	15	20	20	15	10	10	25	15	-	15	20	25
A. niger van Tieghem	15	15	15	15	10	10	15	10	5	10	15	20	80	95	100	60	55	50	60	55	40	45	50	55
A. luchuensis Inui	10	10	15	5	5	10	15	-	-	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	-	-	-	-	-	-	-	-	-	20	35	40	15	20	30	15	10	5	10	5	5
A. nidulans (Eidam) Winter	-	5	10	-	-	5	-	10	5	-	15	20	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	5	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	5	10	15	10	5	10	10	5	30	35	40	25	20	10	20	15	15	15	10	10
Cephalosporium curtipes Saccardo	25	25	30	20	15	10	-	-	-	-	-	-	55	60	70	40	30	20	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	5	-	-	-	-	-	-	-	-	25	30	40	20	15	10	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	20	15	15	-	-	-	-	-	-	30	35	40	20	15	10	20	15	10	20	25	30
T. album Preuss	10	10	10	5	5	-	-	-	-	-	-	-	10	15	20	10	5	5	10	10	5	10	15	20
Fusarium udum Butler	-	-	-	-	-	-	70	90	95	45	40	30	-	-	-	-	-	-	20	30	40	10	5	5
Curvularia pallescens Boedijn	-	10	15	-	5	10	-	20	25	-	15	20	-	5	10	-	5	10	-	10	30	-	15	15
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	-	5	15	15	20	15	10	10	-	15	20	-	10	15	-	30	35	-	20	25
D. hawaiiensis Subram. & Jain ex M.B.Ellis	-	-	5	-	-	-	5	10	15	-	5	10	-	-	15	-	-	10	-	10	20	-	5	10
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	15	-	-	35	-	-	25	-	-	10	-	5	5	-	5	25	-	-	20
Pullularia pullulans (de Bary) Berkhout	15	20	25	10	5	5	20	25	30	10	15	20	10	15	20	5	10	15	15	30	40	10	15	20
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	5	5	10	-	-	-	-	-	-	-	10	20	-	15	30
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	10	10	15	-	-	-	-	-	-	-	10	30	-	15	20
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	15	20	30	-	-	-	-	-	-	15	20	35	10	15	20
Black sterile mycelium	30	35	35	25	20	20	-	-	-	-	-	-	40	45	50	30	30	25	-	-	-	-	-	-

*Number of spray.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

**Calculated on the basis of 20 replicates.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 29. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with F. udum sprayed with brassicol.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	20	20	15	20	15	10	15	10	10	20	20	30	10	15	20	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	10	10	15	10	10	10	15	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	15	20	25	-	-	-	-	-	-	25	20	10	20	30	30
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	5	10	10	20	10	5	15	15	10
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	5	15	20	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	5	5	10
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	15	20	25	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	15	10	10	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	10	10	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	20	15	10	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	50	55	50	60	50	40	55	60	60	50	55	60	50	45	30	55	50	45	60	65	65
A. flavus Link	45	50	60	40	40	35	40	35	30	40	45	50	45	50	60	40	30	20	30	30	25	40	40	45
A. funiculosus G. Smith	10	10	10	10	5	5	20	10	-	15	10	5	15	20	20	10	10	5	10	5	-	5	-	-
A. niger van Tieghem	20	25	30	20	15	15	30	25	20	25	25	30	70	80	85	65	60	55	45	40	30	40	45	45
A. luchuensis Inui	10	15	10	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	10	10	5	30	30	30	30	35	40	30	40	45	25	20	20	15	10	5	10	5	-
A. nidulans (Eidam) Winter	30	30	35	25	20	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius)Thom & Church	20	20	25	15	15	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	-	5	20	10	5	15	10	-	25	30	35	20	15	15	20	15	15	20	25	30
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	25	20	10	20	25	25	15	10	10	10	5	5	15	30	30
A. terricola Marchal	30	35	40	25	20	15	35	30	15	15	10	10	30	40	50	25	25	20	15	10	5	15	15	20
A. sydowi(Bainier & Sartory)Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	35	50	45	30	15	10	25	20	15	20	25	30
Chaetomium flavum Omvik	-	10	10	-	10	5	-	15	30	-	10	5	-	5	10	-	-	5	-	10	20	-	5	15
C. magnum Bainier	-	-	15	-	-	10	-	-	25	-	-	15	-	-	5	-	-	-	-	-	25	-	-	20
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	25	25	15	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	25	25	20	-	-	-	-	-	-	50	55	60	45	40	35	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	10	10	5	-	-	-	-	-	-	20	25	30	15	15	10	-	-	-	-	-	-
C. asperum Marchal	10	10	10	5	5	5	-	-	-	-	-	-	-	-	10	-	-	5	-	-	10	-	-	5
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	5	10	10	-	-	-	-	-	-	10	15	20	10	20	30
Trichoderma viride Pers. ex Fr.	30	30	35	20	10	5	-	-	-	-	-	-	25	30	35	20	15	15	10	15	20	15	20	25
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	-	-	5	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	50	45	35	-	-	-	-	-	-	15	25	30	15	10	5
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	5	-	-	-	-	-	-	-	-	10	15	20	10	5	-
Fusidium viride Grove	-	-	10	-	-	5	-	-	-	-	-	-	-	-	15	-	-	10	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	10	10	5	20	30	40	20	15	15	10	10	10	5	5	5	20	30	40	20	15	15
Curvularia pallescens Boedijn	10	10	10	10	5	5	10	10	10	5	5	5	15	10	15	15	10	10	25	30	35	15	15	10
Alternaria alternata (Fr.) Keissler	-	-	-	-	-	-	10	10	10	10	10	5	10	10	10	5	5	5	15	20	25	10	15	20
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	5	10	15	-	-	-	-	-	-	10	10	15	5	5	10
Hormiscium stilbosporum(Corda)Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	20	10	10
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	-	5	-	-	-	-	-	-	-	5	10	-	-	5
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	-	10	-	-	-	-	-	-	-	5	10	-	-	5
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	10	15	20	-	-	-	-	-	-	10	10	10	10	15	20
Black sterile mycelium	10	15	20	5	10	15	-	-	-	-	-	-	20	25	30	-	-	-	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP - Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 28. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with F. udum, sprayed with vitavax.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
<u>Rhizopus oryzae</u> Went & Gerlings	15**	25	30	10	15	20	20	15	10	20	20	25	10	15	30	10	10	5	-	-	-	-	-	-
<u>R. nigricans</u> Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	10	10	15	10	10	10	15	15
<u>Cunninghamella echinulata</u> Thaxter	-	-	-	-	-	-	10	10	10	10	5	5	-	-	-	-	-	-	20	15	15	15	20	20
<u>C. bertholletiae</u> Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	5	10	15	10	10	15	5	10	15
<u>Circinella tenella</u> (Ling-Young) Zycha	20	25	30	20	15	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Mucor globosus</u> Fischer	-	-	-	-	-	-	10	15	30	15	20	25	-	-	-	-	-	-	-	-	-	-	-	-
<u>M. mucedo</u> (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	10	20	25
<u>Syncephalastrum racemosum</u> (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	10	15	20	-	-	-	-	-	-
<u>Aspergillus fumigatus</u> Fresenius	60	60	60	55	50	40	60	55	50	50	55	60	50	60	60	50	40	35	50	45	40	40	45	50
<u>A. flavus</u> Link	40	45	50	40	35	30	45	40	35	45	50	50	35	40	45	30	30	25	30	30	25	25	30	35
<u>A. funiculosus</u> G. Smith	20	25	30	15	15	10	30	-	-	-	-	-	15	20	20	10	10	5	25	15	-	15	20	25
<u>A. niger</u> van Tieghem	15	15	15	15	10	10	15	10	5	20	30	30	80	85	100	70	60	55	60	55	40	35	40	45
<u>A. luchuensis</u> Inui	10	10	15	5	5	10	15	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>A. terreus</u> Thom	-	-	5	-	-	-	-	-	-	-	-	-	20	35	40	10	10	10	15	10	5	10	15	15
<u>A. nidulans</u> (Eidam) Winter	-	5	10	-	-	5	-	10	5	5	10	15	-	-	-	-	-	-	-	-	-	-	-	-
<u>A. sulphureus</u> (Fresenius) Thom & Church	10	10	20	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>A. candidus</u> Link	-	10	15	-	10	10	15	10	5	20	25	30	30	35	40	25	20	20	20	15	15	15	10	10
<u>Cephalosporium curtipes</u> Saccardo	25	25	30	20	15	15	-	-	-	-	-	-	55	60	70	50	45	40	-	-	-	-	-	-
<u>C. roseo-griseum</u> Saksena	10	15	20	5	10	15	-	-	-	-	-	-	25	30	40	20	20	15	-	-	-	-	-	-
<u>Trichoderma viride</u> Pers. ex Fr.	20	25	25	20	20	15	-	-	-	-	-	-	30	35	40	30	25	20	20	15	10	10	15	20
<u>T. album</u> Preuss	10	10	10	5	5	5	-	-	-	-	-	-	10	15	20	10	5	5	10	10	5	5	5	10
<u>Fusarium udum</u> Butler	-	-	-	-	-	-	70	80	85	45	35	25	-	-	-	-	-	-	20	30	40	10	5	-
<u>Drechslera australiensis</u> Subram. & Jain ex M.B. Ellis	-	-	10	-	-	5	15	15	20	10	15	15	-	15	20	-	10	15	-	30	35	-	10	15
<u>D. hawaiensis</u> Subram.& Jain ex M.B. Ellis	-	-	5	-	-	-	5	10	15	5	5	5	-	-	15	-	-	10	-	10	20	-	5	5
<u>Curvularia pallescens</u> Boedijn	-	10	15	-	10	15	-	20	25	-	10	15	-	5	10	-	-	5	-	10	30	-	5	10
<u>Helminthosporium sativum</u> Pammel, King & Bakke	-	-	20	-	-	15	-	-	35	-	-	10	-	-	10	-	-	10	-	5	25	-	-	15
<u>Pullularia pullulans</u> (de Bary) Berkhout	15	20	25	10	15	20	20	25	30	15	15	10	10	15	20	5	10	15	15	30	40	10	15	20
<u>Rhizoctonia solani</u> Kuhn	-	-	-	-	-	-	-	10	20	-	5	10	-	-	-	-	-	-	-	10	20	-	5	10
<u>Sclerotium rolfsii</u> Saccardo	-	-	-	-	-	-	-	15	20	-	5	10	-	-	-	-	-	-	-	10	30	-	5	10
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	15	20	30	-	-	-	-	-	-	15	20	25	10	15	15
Black sterile mycelium	30	35	35	25	20	20	-	-	-	-	-	-	40	45	50	30	40	40	-	-	-	-	-	-

*Number of spray.

UCP = Uninoculated control plants

UP = Uninoculated plants.

**Calculated on the basis of 20 replicates.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 27. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with *F. udum*, sprayed with vitavax.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	20	20	15	20	15	10	15	10	10	20	20	30	10	10	10	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	10	5	15	10	10	10	15	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	25	20	20	-	-	-	-	-	-	25	20	10	20	20	15
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	10	10	5	20	10	5	15	5	-
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	10	15	20
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	5	10	15	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	15	20	25	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	10	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	20	20	25	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	55	50	45	60	50	40	60	65	70	50	55	60	40	30	20	55	50	45	55	60	65
A. flavus Link	45	50	60	40	30	20	40	35	30	40	45	50	45	50	60	40	35	25	30	30	25	30	35	40
A. funiculosus G. Smith	10	10	10	5	-	-	20	10	-	10	5	-	15	20	20	10	5	-	10	5	-	5	-	-
A. niger van Tieghem	20	25	30	15	10	10	30	25	20	35	40	45	70	80	85	65	60	55	45	40	30	40	45	50
A. luchuensis Inui	10	15	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	5	5	5	30	30	30	35	40	45	30	40	45	25	20	20	15	10	5	10	5	-
A. nidulans (Eidam) Winter	30	30	35	25	20	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	20	20	25	15	15	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	-	-	20	10	5	25	15	-	25	30	35	20	20	15	20	15	15	15	10	10
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	30	35	40	20	25	25	20	15	10	10	5	5	5	-	-
A. terricola Marchal	30	35	40	25	20	20	35	30	15	25	25	10	30	40	50	25	25	30	15	10	5	10	15	20
A. sydowi (Bainier & Sartory) Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	30	25	20	25	20	15	20	25	30
Chaetomium flavum Omvik	-	10	10	-	10	5	-	15	30	-	10	15	-	5	10	-	5	15	-	10	20	-	5	10
C. magnum Bainier	-	-	15	-	-	10	-	-	25	-	-	10	-	-	5	-	-	10	-	-	25	-	-	15
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	25	20	20	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	25	20	15	-	-	-	-	-	-	50	55	60	45	40	35	-	-	-	-	-	-
C. roseogriseum Saksena	15	20	30	15	10	10	-	-	-	-	-	-	20	25	30	20	15	10	-	-	-	-	-	-
C. aspermum Marchal	10	10	10	5	-	-	-	-	-	-	-	-	-	-	10	-	-	5	-	-	10	-	-	5
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	10	15	20	-	-	-	-	-	-	10	15	20	5	10	15
Trichoderma viride Pers.ex Fr.	30	30	35	20	10	5	-	-	-	-	-	-	25	30	35	20	15	15	10	15	20	5	10	15
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	5	-	-	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	55	45	35	-	-	-	-	-	-	15	25	30	15	10	10
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	5	5	-	-	-	-	-	-	-	10	15	20	10	5	5
Fusidium viride Grove	-	-	10	-	-	5	-	-	-	-	-	-	-	-	15	-	-	10	-	-	-	-	-	-
Drechslera australiensis Subram.& Jain ex M.B. Ellis	10	15	15	10	10	5	20	30	40	15	10	5	10	10	10	10	10	5	20	30	40	15	10	5
Curvularia pallescens Boedijn	10	10	10	10	5	5	10	10	10	5	5	5	15	10	15	10	5	5	25	30	35	15	15	10
Alternaria alternata (Fr) Keissler	-	-	-	-	-	-	10	10	10	5	5	5	10	10	10	10	5	5	15	20	25	10	10	5
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	5	5	10	-	-	-	-	-	-	10	10	15	5	5	5
Hormiscium stilbosporum (Corda)Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	10	5	5
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	5	5	-	-	-	-	-	-	-	5	10	-	-	5
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	-	5	-	-	-	-	-	-	-	5	10	-	5	5
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	10	15	20	-	-	-	-	-	-	10	10	10	10	15	20
Black sterile mycelium	10	15	20	5	10	15	-	-	-	-	-	-	20	25	30	15	20	25	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 26. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with F. udum, sprayed with bavistin.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	15	10	10	20	15	10	20	25	30	10	15	30	15	10	10	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	10	10	15	10	10	20	25	30
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	15	15	20	-	-	-	-	-	-	20	15	15	20	20	25
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	10	10	10	10	10	5	10	15	20
Circinella tenella (Ling-Young) Zycha	20	25	30	20	20	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	15	20	35	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	25
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	10	15	20	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	60	55	50	60	55	50	65	70	70	50	60	60	50	45	40	50	45	40	55	60	60
A. flavus Link	40	45	50	35	30	25	45	40	35	45	50	55	35	40	45	30	30	25	30	30	25	35	40	45
A. funiculosus G. Smith	20	25	30	20	20	15	30	-	-	35	30	15	15	20	20	10	15	15	25	15	10	30	25	15
A. niger van Tieghem	15	15	15	15	10	10	15	10	5	20	25	35	80	85	100	70	60	50	60	55	40	70	75	80
A. luchuensis Inui	10	10	15	15	10	5	15	-	-	20	10	5	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	-	-	-	-	-	-	-	-	-	20	35	40	15	10	10	15	10	5	15	20	25
A. nidulans (Eidam) Winter	-	5	10	-	-	5	-	10	5	-	15	20	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	5	5	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	5	10	15	10	5	15	10	5	30	35	40	25	20	20	20	15	15	20	25	30
Cephalosporium curtipes Saccardo	25	25	30	20	20	15	-	-	-	-	-	-	55	60	70	50	45	40	-	-	-	-	-	-
C. roseo-griseum Saksena	10	15	20	10	5	5	-	-	-	-	-	-	25	30	40	20	15	10	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	15	10	5	-	-	-	-	-	-	30	35	40	25	20	15	20	15	10	25	30	35
T. album Preuss	10	10	10	5	5	-	-	-	-	-	-	-	10	15	20	10	5	5	10	10	5	15	20	25
Fusarium udum Butler	-	-	-	-	-	-	70	80	85	40	30	20	-	-	-	-	-	-	20	30	40	5	-	-
Curvularia pallescens Boedijn	-	10	15	-	10	10	-	20	25	-	5	10	-	5	10	-	-	5	-	10	30	-	5	10
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	-	5	15	15	20	15	10	5	-	15	20	-	10	15	-	30	35	-	15	10
D. hawaiiensis Subram.& Jain ex M.B. Ellis	-	-	5	-	-	-	5	10	15	5	5	5	-	-	15	-	-	10	-	10	20	-	5	5
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	15	-	-	35	-	10	15	-	-	10	-	-	5	-	5	25	-	5	10
Pullularia pullulans (de Bary) Berkhout	15	20	25	10	10	5	20	25	30	15	10	5	10	15	20	10	10	10	15	30	40	10	5	5
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	10	5	-	-	-	-	-	-	-	10	20	-	5	5
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	10	10	-	-	-	-	-	-	-	10	30	-	5	15
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	15	20	30	-	-	-	-	-	-	15	20	25	10	15	20
Black sterile mycelium	30	35	35	25	20	20	-	-	-	-	-	-	40	45	50	35	30	25	-	-	-	-	-	-

*Number of spray.
**Calculated on the basis of 20 replicates.
UCP = Uninoculated control plants.
ICP = Inoculated control plants.
UP = Uninoculated plants.
IP = Inoculated plants.

TABLE 25. Frequency (percentage) of fungi in the rhizosphere of pigeonpea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with F. udum, sprayed with bavistin.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	25**	30	30	20	15	10	20	15	10	15	20	20	20	20	30	20	15	15	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	15	10	5	5	10	10	10	10	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	30	25	20	25	30	30	-	-	-	-	-	-	25	20	10	25	30	30
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	15	10	5	5	20	10	5	25	30	20
Mucor globosus Fischer	-	-	-	-	-	-	10	10	15	15	15	10	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	15	15	20	25
M. racemosus Fresenius	-	-	-	-	-	-	10	15	20	25	15	10	-	-	-	-	-	-	-	-	-	-	-	-
Mortierella alpina Peyroud	-	-	-	-	-	-	20	25	30	25	15	10	-	-	-	-	-	-	-	-	-	-	-	-
Circinella tenella (Ling-Young) Zycha	10	20	30	10	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syncephalastrum racemosum (Cohn)Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	25	30	35	20	20	15	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	65	60	55	50	40	60	50	40	65	70	70	50	55	60	45	40	35	55	50	45	60	60	65
A. flavus Link	45	50	60	40	35	25	40	35	30	40	45	50	45	50	60	40	35	30	30	30	25	35	40	40
A. funiculosus G. Smith	10	10	10	10	5	-	20	10	-	15	10	-	15	20	20	10	5	5	10	5	-	5	10	10
A. niger van Tieghem	20	25	30	15	10	10	30	25	20	35	40	40	70	80	85	60	55	50	45	40	30	40	45	50
A. luchuensis Inui	10	15	10	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	10	15	10	10	5	-	30	30	30	35	40	40	30	40	45	25	30	30	15	10	5	15	20	25
A. nidulans (Eidam) Winter	30	30	35	25	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	20	20	25	10	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	5	10	-	-	5	20	10	5	25	20	10	25	30	35	20	15	15	20	15	15	20	20	15
A. ustus (Bainier) Thom & Church	-	-	-	-	-	-	30	25	20	35	40	40	20	25	25	15	20	20	10	5	5	15	30	35
A. terricola Marchal	30	35	40	25	20	10	35	30	15	35	40	45	30	40	50	25	20	15	15	10	5	20	25	30
A. zydowi (Bainier & Sartory) Thom & Church	-	-	-	-	-	-	-	-	-	-	-	-	35	40	45	25	20	10	25	20	15	15	25	30
Chaetomium flavum Omvik	-	10	10	-	5	5	-	15	30	-	20	15	-	5	10	-	-	5	-	10	20	-	5	10
C. magnum Bainier	-	-	15	-	-	10	-	-	25	-	-	20	-	-	5	-	-	-	-	-	25	-	-	20
Gelasinospora cerealis Gilman & Abbott	-	-	10	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Penicillium chrysogenum Thom	-	-	-	-	-	-	-	-	-	-	-	-	30	35	40	25	20	15	-	-	-	-	-	-
Cephalosporium curtipes Saccardo	30	35	40	25	15	10	-	-	-	-	-	-	50	55	60	45	40	35	-	-	-	-	-	-
C. roseo-griseum Saksena	15	20	30	10	5	-	-	-	-	-	-	-	20	25	30	15	15	10	-	-	-	-	-	-
C. aspermum Marchal	10	10	10	5	5	-	-	-	-	-	-	-	-	-	10	-	-	5	-	-	10	-	5	15
Monosporium olivaceum Cooke & Massee	-	-	-	-	-	-	10	10	10	15	10	5	-	-	-	-	-	-	10	15	20	15	10	10
Trichoderma viride Pers. ex Fr.	30	30	35	25	20	15	-	-	-	-	-	-	25	30	35	20	15	10	10	15	20	25	30	35
T. lignorum (Tode) Harz	-	-	-	-	-	-	-	-	-	-	-	-	5	5	10	5	5	5	-	-	-	-	-	-
Fusarium udum Butler	-	-	-	-	-	-	65	70	70	50	40	30	-	-	-	-	-	-	15	25	30	10	5	-
F. oxysporum Schlecht	-	-	-	-	-	-	10	10	20	-	-	-	-	-	-	-	-	-	10	15	20	10	10	5
Fusidium viride Grove	-	-	10	-	-	5	-	-	-	-	-	-	-	-	15	-	-	10	-	-	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	10	15	15	5	10	10	20	30	40	20	20	15	10	10	10	5	5	5	20	30	40	15	10	10
Curvularia pallescens Boedijn	10	10	10	5	5	5	10	10	10	5	10	10	15	10	15	10	10	10	25	30	35	25	20	15
Alternaria alternata(Fr.) Keissler	-	-	-	-	-	-	10	10	10	10	10	10	10	10	10	5	5	5	15	20	25	15	10	10
Helminthosporium sativum Pammel, King & Bakke	-	-	-	-	-	-	10	15	20	15	10	5	-	-	-	-	-	-	10	10	15	5	5	-
Hormiscium stilbosporum (Corda)Saccardo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	20	25	15	10	5
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	5	10	-	-	10	-	-	-	-	-	-	-	5	10	-	-	5
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	5	10	-	10	5	-	-	-	-	-	-	-	5	10	-	5	5
Yellow sterile mycelium	-	-	-	-	-	-	10	10	10	-	5	10	-	-	-	-	-	-	10	10	10	5	5	5
Black sterile mycelium	10	15	20	5	10	15	-	-	-	-	-	-	20	25	30	20	15	10	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

UP = Uninoculated plants.

ICP = Inoculated control plants.

IP = Inoculated plants.

TABLE 42. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants (cultivars T-21 and BDN-1), uninoculated and inoculated with F. udum, sprayed with streptomycin.

Fungi isolated	T - 21												BDN - 1											
	UCP			UP			ICP			IP			UCP			UP			ICP			IP		
	I*	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
Rhizopus oryzae Went & Gerlings	15**	25	30	20	30	35	20	15	10	25	20	15	10	15	30	15	20	35	-	-	-	-	-	-
R. nigricans Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	20	25	30	25	30	40	15	10	10	20	15	15
Cunninghamella echinulata Thaxter	-	-	-	-	-	-	10	10	10	15	10	10	-	-	-	-	-	-	20	15	15	25	20	20
C. bertholletiae Stadel	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	25	10	10	5	15	15	10
Circinella tenella (Ling-Young) Zycha	20	25	30	25	30	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor globosus Fischer	-	-	-	-	-	-	10	15	30	15	20	35	-	-	-	-	-	-	-	-	-	-	-	-
M. mucedo (Linne) Brefeld	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	20	15	20	25
Syncephalastrum racemosum (Cohn) Schroeter	-	-	-	-	-	-	-	-	-	-	-	-	15	20	30	20	25	35	-	-	-	-	-	-
Aspergillus fumigatus Fresenius	60	60	60	65	70	70	60	55	50	65	60	55	50	60	60	55	65	70	50	45	40	55	50	45
A. flavus Link	40	45	50	50	55	60	45	40	35	50	45	40	35	40	45	40	45	50	30	30	25	35	35	30
A. funiculosus G. Smith	20	25	30	25	30	35	30	-	-	35	-	-	15	20	20	20	25	25	25	15	-	30	20	-
A. niger van Tieghem	15	15	15	20	25	25	15	10	5	25	20	15	80	85	100	90	95	100	60	55	40	65	60	45
A. luchuensis Inui	10	10	16	15	20	25	15	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	5	-	-	15	-	-	-	-	-	-	20	35	40	25	40	45	15	10	5	20	15	10
A. nidulans (Eidam) Winter	-	5	10	-	10	20	-	10	5	-	15	10	-	-	-	-	-	-	-	-	-	-	-	-
A. sulphureus (Fresenius) Thom & Church	10	10	20	15	20	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. candidus Link	-	10	15	-	15	30	15	10	5	20	15	10	30	35	40	35	40	45	20	15	15	25	20	20
Cephalosporium curtipes Saccardo	25	25	30	30	30	35	-	-	-	-	-	-	55	60	70	60	55	75	-	-	-	-	-	-
C. rosae-griseum Saksena	10	15	20	15	20	30	-	-	-	-	-	-	25	30	40	30	35	45	-	-	-	-	-	-
Trichoderma viride Pers. ex Fr.	20	25	25	25	35	35	-	-	-	-	-	-	30	35	40	35	40	45	20	15	10	25	20	15
T. album Preuss	10	10	10	20	25	25	-	-	-	-	-	-	10	15	20	15	20	25	10	10	5	15	15	10
Fusarium udum Butler	-	-	-	-	-	-	70	80	85	75	85	95	-	-	-	-	-	-	20	30	40	25	35	45
Curvularia pallescens Boedijn	-	10	15	-	15	20	-	20	25	-	30	35	-	5	10	-	15	20	-	10	30	-	15	35
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	-	10	-	-	20	15	15	20	20	20	35	-	15	20	-	20	25	-	30	35	-	45	50
D. hawaiiensis Subram.& Jain ex M.B.Ellis	-	-	5	-	-	15	5	10	15	10	15	20	-	-	15	-	-	20	-	10	20	-	15	25
Helminthosporium sativum Pammel, King & Bakke	-	-	20	-	-	25	-	-	35	-	-	40	-	-	10	-	-	15	-	5	25	-	10	35
Pullularia pullulans (de Bary) Berkhout	15	20	25	20	25	30	20	25	30	25	30	40	10	15	20	15	20	25	15	30	40	20	35	45
Rhizoctonia solani Kuhn	-	-	-	-	-	-	-	10	20	-	15	25	-	-	-	-	-	-	-	10	20	-	15	25
Sclerotium rolfsii Saccardo	-	-	-	-	-	-	-	15	20	-	20	25	-	-	-	-	-	-	-	10	30	-	20	35
Yellow sterile mycelium	-	-	-	-	-	-	20	30	40	25	35	40	-	-	-	-	-	-	15	20	35	20	25	40
Black sterile mycelium	30	35	35	35	40	45	-	-	-	-	-	-	40	45	50	50	55	60	-	-	-	-	-	-

*Number of spray.

**Calculated on the basis of 20 replicates.

UCP = Uninoculated control plants.

ICP = Inoculated control plants.

UP = Uninoculated plants.

IP = Inoculated plants.

4. **RHIZOSPHERE AND RHIZOPLANE MYCOFLORA OF UNINOCULATED AND INOCULATED PLANTS (WITH *FUSARIUM UDUM* BUTLER) OF PIGEON PEA CULTIVARS T-21 AND BDN-1 IN RELATION TO SOIL AMENDMENTS.**

A perusal of tables 44, 45 and 47 reveals that the number of fungal species isolated from the rhizosphere of uninoculated plants treated with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur was 25, 25, 25, 29, 27, 27, 27 26, 17, 17, 23, 19, 24, 25 and 25 respectively as compared to 25 in control in the cultivar T-21; and 30, 30, 30, 35, 35, 35, 35, 35, 26, 26, 26, 27, 28, 30 and 30 as compared to 30 in control in the cultivar BDN-1. However, in the rhizosphere of inoculated plants for the corresponding treatments the number of fungal species recorded was 29, 29, 23, 30, 34, 32, 29, 33, 21, 22, 24, 24, 24, 23 and 23 respectively as compared to 24 in control in T-21 and 29, 28, 33, 35, 35, 35, 35, 35, 23, 23, 24, 23, 23, 26 and 25 as compared to 28 in control in the cultivar BDN-1. On the other hand in the non-rhizosphere soil the number of fungal species for the corresponding treatments was 22, 22, 22, 22, 22, 22, 22, 22, 20, 20, 22, 21, 22, 22 and 22 respectively as compared to 22 in control. It is clear from the above results that in the rhizosphere of uninoculated plants of both the cultivars T-21 and BDN-1, the number of fungal species increased in the treatments with neem cake, groundnut cake, mahua cake, castor cake and mustard cake treatments; and decreased in bavistin, vitavax, brassicol, benlate and fotylan treatments in comparison to control; however, in the rest of the treatments no change in the number of fungal species was recorded in comparison to control. In the rhizosphere of inoculated plants of cultivar T-21, the number of fungal species increased in urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake and mustard cake treatments, and decreased in bavistin, vitavax, captan and wettable sulphur treatments. In the rest of the treatments no change in the number of fungal species was recorded as a result of amendment. In the cultivar BDN-1, the number of fungal species increased in neem cake, groundnut cake, mahua cake, castor cake and mustard cake treatments, and decreased in bavistin, vitavax, brassicol, benlate and fytolan treatments. In the rest of treatments no change in the number of fungal species was recorded in comparison to control. In the non-rhizosphere soil no change in the number of fungal species was noticed as a result of amendments except in treatments with bavistin, vitavax, and benlate where a decrease in number of fungal species was noticed. In the cultivar T-21, the number of fungal species in the rhizosphere of inoculated plants was higher as compared to their healthy counterparts in treatments with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, brassicol and benlate; however, with captan and wettable sulphur a reverse trend was noticed. In the cultivar BDN-1, the number of fungal species in the rhizosphere of inoculated plants was higher in comparison to their healthy counterparts in treatment with potash; an opposite trend was observed with urea, superphosphate, bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur.

Fig. 5 & 6 and table 43 indicate that fungal population recorded from the rhizosphere of uninoculated plants treated with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur was 140500, 148000, 143000, 136000, 139000, 123000, 136500, 139800, 118300, 119200, 123800, 122950, 123200, 124000 and 127000 respectively as compared to 130000 in control in cultivar T-21 and 82000, 89000, 86000, 80500, 81000, 76000, 80700, 81900, 71000, 72200, 76900, 75800, 76500, 77200 and 78000 as compared to 79000 in control in the cultivar BDN-1. However, in the rhizosphere of inoculated plants, the population of fungi recorded for the corresponding treatments was 432000, 440000, 320000, 260000, 280000, 210000, 270000, 290000, 185000, 192000, 222000, 215000, 220000, 226000 and 230000 as compared to 428000 in control in cultivar T-21 and 106000, 110000, 90000, 80900 , 82000, 78000, 81100, 83000, 75000, 76200, 86100, 83000 , 85500, 87300 and 89000 as compared to 100000 in control in cultivar BDN-1. Whereas in the non-rhizosphere soil, the population of fungi for the corresponding treatments was 20300, 22800, 21100, 18000, 19000, 14000, 18800, 19500, 12300, 12900, 14200, 13900, 14000, 14500 and 15000 as compared to 16000 in control. The R:S ratio for the corresponding treatment in the rhizosphere of uninoculated plants was 6.92, 7.29, 6.77, 7.55, 7.31, 8.78, 7.23, 7.16, 9.61, 9.24, 8.71, 8.84, 8.30, 8.55 and 8.46 as compared to 8.12 in control in the cultivar T-21; and 4.03, 3.90, 4.07, 4.47, 4.26, 5.42, 4.29, 4.20, 5.77, 5.59, 5.41, 5.45, 5.46, 5.33 and 5.70 as compared to 4.93 in control in BDN-1. However, in the rhizosphere of inoculated plants the R:S ratio was 21.28, 19.29, 15.16, 14.44, 14.73, 15.00, 14.36, 14.87, 15.04, 14.88, 15.63, 15.46, 15.71, 15.58 and 15.33 as compared to 26.75 in control in cultivar T-21 and 5.22, 4.82, 4.26, 4.49, 4.31, 5.57, 4.31, 4.25, 6.09, 5.90, 6.06, 5.97, 6.10, 6.02 and 5.93 as compared to 6.25 in control in the cultivar BDN-1. It is clear from the above results that in the rhizosphere of uninoculated plants of cultivars T-21 and BDN-1, the population of fungi increased with the treatments of urea, superphosphate, potash, neem cake, groundnut cake, castor, cake, mustard cake and decreased with mahua cake, bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur. A similar trend was noticed in the non-rhizosphere soil. However, in the rhizosphere of inoculated plants of both the cultivars, the population of fungi increased with the treatments of urea and superphosphate and decreased with the rest of the treatments. Higher fungal population was recorded in the rhizosphere of inoculated plants of both the cultivars in all the treatments in comparison to their uninoculated counterparts.

A perusal of tables 44, 45 and 47 reveals that Aspergillus fumigatus, A. flavus, A. niger and Curvularia pallescens were commonly recorded from treated and untreated rhizosphere and non-rhizosphere soils. In the cultivar T-21, Rhizopus oryzae, Aspergillus fumigatus, A. funiculosus, A. flavus, A. niger, Chaetomium magnum, Gelasinospora cerealis, Curvularia pallescens and Cladosporium herbarum were recorded from uninoculated and inoculated rhizosphere in all the treatments. In the cultivar BDN-1, Rhizopus nigricans, Cunninghamella bertholletiae, Aspergillus fumigatus, A. flavus, A. niger, A. candidus, A. ustus, Chaetomium magnum, Monilia brunnea, Gelasinospora cerealis, Drechslera australiensis and Curvularia pallescens were recorded from the rhizosphere of uninoculated and inoculated plants in all the treatments. Rest of the fungi did not follow any definite pattern of occurrence.

A perusal of table 46 reveals that in the rhizosphere of uninoculated plants of cultivar T-21, the frequency of Rhizopus oryzae, Mortierella alpina, Aspergillus fumigatus,

A. _funiculosus_, A. _niger_, A. _luchuensis_, A. _terreus_, A. _nidulans_, A. _candidus_, A. _terricola_, _Cephalosporium curtipes_, C. _roseo-griseum_ increased in treatments with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake and mustard cake; and decreased in treatment with bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur in comparison to control. A similar trend was also observed by _Circinella tenella_, _Aspergillus flavus_, _Gelasinospora cerealis_ and _Trichoderma viride_ except in treatment with mahua cake; where the frequency value decreased. _Aspergillus terricola_ was completely eliminated in treatments with bavistin, vitavax, brassicol, benlate and fytolan; A. _candidus_ in bavistin, vitavax, brassicol and benlate; A. _luchuensis_, A. _terreus_ and A. _nidulans_ in bavistin, vitavax and benlate; _Cephalosporium roseo-griseum_ in bavistin and vitavax. On the other hand, the frequency of _Drechslera australiensis_, _Curvularia pallescens_ and _Cladosporium herbarum_ increased in treatments with urea, superphosphate and decreased in treatments with potash, neem cake, ground nut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur. A similar trend was also noticed in _Fusarium oxysporum_ except in captan and wettable sulphur, where no change in the frequency was observed. _Fusarium oxysporum_ was completely eliminated in the treatments with mahua cake, castor cake, bavistin and vitavax and _Drechslera australiensis_ in mustard cake treatment. In the rhizosphere of inoculated plants the frequency of Rhizopus oryzae, Aspergillus fumigatus, A. funiculosus, A. flavus, A. niger, Gelasinospora cerealis increased in all the treatments in comparison to control, however, no change in frequency was observed in the case of A. funiculosus in treatments with captan and wettable sulphur, R. oryzae in bavistin and vitavax and G. cerealis in bavistin, vitavax and brassicol. Aspergillus luchuensis, A. terreus, A. nidulans, A. candidus and A. terricola appeared in treatments with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, and were absent in control. On the other hand, the frequency of Pyrenochaeta cajani, Fusarium udum, F. oxysporum, Drechslera australiensis, Curvularia pallescens, Alternaria alternata, Helminthosporium sativum, Cladosporium herbarum, Rhizoctonia solani and Sclerotium rolfsii increased in treatments with urea and superphosphate and decreased with rest of the treatments. Pyrenochaeta cajani was completely eliminated in treatments with neem cake, castor cake, bavistin, vitavax and benlate; Fusarium udum in neem cake, mahua cake, castor cake, bavistin, vitavax and benlate; F. oxysporum in neem cake, castor cake, bavistin and vitavax; Alternaria alternata and Helminthosporium sativum in castor cake; Rhizoctonia solani in castor cake; and Sclerotium rolfsii in mahua and castor cake.

It is evident from table 47 that in the rhizosphere of uninoculated plants of cultivar BDN-1, the frequency of Rhizopus oryzae, R. nigricans, Syncephalastrum racemosum, Aspergillus fumigatus, A. funiculosus, A. flavus, A. niger, A. terreus, A. candidus, A. ustus, A. terricola, Penicillium chrysogenum, Chaetomium magnum, Cephalosporium curtipes, C. roseo-griseum, Gelasinospora cerealis, Trichoderma viride, T. lignorum, T. album, Fusidium viride, white sterile mycelium and black sterile mycelium increased in treatments with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake and decreased in bavistin, vitavax, brassicol, benlate, flytolan, captan and wettable sulphur; however, R. oryzae did not respond to wettable sulphur treatment; R. nigricans to captan and wettable sulphur; A. candidus wettable sulphur; A. ustus vitavax, brassicol, benlate, fytolan, captan and wettable sulphur; A. terricola wettable sulphur; C. magnum captan and wettable sulphur; T. album captan and wettable sulphur; white sterile mycelium wettable sulphur; and black sterile mycelium brassicol, benlate, fytolan and wettable sulphur. The frequency of Fusarium oxysporum, Drechslera australiensis, Curvularia pallescens, Cladosporium herbarum increased in treatments with urea and superphosphate and decreased in the rest of the treatments. In the rhizosphere of inoculated plants, the frequency of Aspergillus fumigatus, A. funiculosus, A. flavus, A. niger increased in treatments with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake and mustard cake. The frequency of Aspergillus fumigatus and

A. *funiculosus* decreased in all the fungicidal treatments; A. *flavus* decreased in treatments with bavistin, benlate and increased in the rest of the fungicidal treatments, however, in vitavax no change was observed; A. *niger* decreased in bavistin and increased in rest of the treatments, however, no change was observed in vitavax and captan. *Syncephalastrum racemosum*, *Aspergillus terreus*, A. *terricola*, A. *sydowi*, *Penicillium chrysogenum*, *Cephalosporium curtipes*, C. *roseo-griseum*, *Trichoderma album*, *Fusidium viride*, white sterile mycelium and black sterile mycelium appeared in treatments with potash and oil cakes and were absent in control. The frequency of *Rhizopus nigricans* decreased in urea, superphosphate, castor cake, bavistin, vitavax, brassicol, benlate, fytolan and increased in neem cake, mahua cake, mustard cake, however in the rest of the treatments no change in the frequency was observed. The frequency of *Aspergillus candidus* and A. *ustus* decreased in urea, superphosphate and in all the fungicidal treatments, and increased in potash and oil cakes amendments. The frequency of *Monilia brunnea* and *Gelasinospora cerealis* increased in amendments with potash and oilcakes, however in the fungicidal treatments the frequency decreased. The frequency of *Trichoderma viride* increased in all the oil cake amendments, urea and potash, and decreased in the rest of the treatments except superphosphate and captan, where no change was observed. However, the frequency of *Pyrenochaeta cajani*, *Fusarium udum*, F. *oxysporum*, *Drechslera* *australiensis*, *Curvularia pallescens*, *Alternaria alternata*, *Helminthosporium sativum*, *Cladosporium herbarum*, *Rhizoctonia solani* and *Sclerotium rolfsii* increased in amendments with urea and superphosphate and decreased in the rest of the treatments. *Fusarium udum* was completely eliminated in treatments with potash, neemcake, groundnut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, brassicol, benlate and fytolan; *F. oxysporum* in benlate and fytolan; *Hormiscium stilbosporum* in bavistin, vitavax, brassicol, benlate and fytolan, *Rhizoctonia solani* and *Sclerotium rolfsii* in neem cake, groundnut cake, mahua cake, castor cake and mustard cake.

It is evident from table 44 that in the non-rhizosphere soil, the frequency of *Rhizopus oryzae*, *Cunninghamella bertholletiae*, *Aspergillus fumigatus*, *A. flavus*, *A. niger*, *A. luchuensis*, *A. terreus*, *A. ochraceous*, *A. nidulans*, *Cephalosporium curtipes*, *C. aspermum*, *Monilia geophila*, *M. brunnea*, *Fisidum viride* and white sterile mycelium increased in amendments with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, and decreased in bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur. No change in the frequency was observed in *Rhizopus oryzae* and *Aspergillus ochraceous* with brassicol, fytolan, captan and wettable sulphur; *Cunninghamella echinulata* with wettable sulphur; *Aspergillus fumigatus*, *A. flavus*, *A. terreus*, *A. nidulans*, *Cephalosporium curtipes*, *Monilia brunnea*, *Fusidium viride* and white sterile mycelium with captan and wettable sulphur. On the other hand, the frequency of *Pyrenochaeta cajani*, *Phoma hibernica*, *Fusarium oxysporum*, *Drechslera australiensis*, *Curvularia pallescens*, *Alternaria alternata* and *Cladosporium herbarum* increased in treatments with urea and superphosphate and decreased in rest of the treatments. However, frequency of *Phoma hibernica* and *Drechslera australiensis* did not respond to wettable sulphur, *Cladosporium herbarum* to captan and wettable sulphur; *Pyrenochaeta cajani* fytolan, captan and wettable sulphur.

A perusal of table 46 and 48 reveals that the number of fungal species isolated from the rhizoplane of uninoculated plants amended with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, bressicol, benlate, fytolan, captan and wettable sulphur was 20, 20, 20, 22, 22, 23, 23, 21, 15, 15, 18, 16, 19, 20 and 20 respectively as compared to 20 in control in the cultivar T-21; and 21, 21, 21, 26, 26, 26, 26, 26, 20, 20, 20, 20, 21, 21 and 21 respectively as compared to 21 in control in the cultivar BDN-1. However, in the rhizoplane of inoculated plants for the corresponding treatments 25, 25, 25, 26, 30, 27, 25, 30, 20, 21, 23, 23, 22, 21 and 21 respectively as compared to 21 in control in the cultivar T-21; and 25, 25, 28, 26, 26, 26, 26, 26, 21, 21, 22, 21, 21, 24 and 23 as compared to 24 in control in the cultivar BDN-1. It is clear from the above results that in the rhizoplane of uninoculated plants of T-21, the number of fungal species increased in neem cake, groundnut cake, mahua cake, castor cake and mustard cake treatments and decreased in bavistin, vitavax, brassicol, benlate and fytolan, however in the rest of treatments no change was observed. Similarly, in the cultivar BDN-1, the number of fungal species increased in neem cake, groundnut cake, mahua cake, castor cake and mustard cake treatments and decreased in bavistin, vitavax, brassicol and benlate; however in the rest of treatments no change was observed. On the other hand, in the rhizoplane of inoculated plants of cultivar T-21, the number of fungal species increased in urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, brassicol, benlate and fytolan treatments and decreased in only bavistin; however in the rest of treatments no change was observed. In the cultivar BDN-1, the number of fungal species increased in urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake and mustard cake treatments and decreased in bavistin, vitavax, brassicol, benlate, fotylan and wettable sulphur; however, in captan no change was observed. In the cultivar T-21 and BDN-1, higher number of fungal species was recorded in the rhizoplane of inoculated plants as compared to their uninoculated counterparts in all the treatments; however, in the cultivar BDN-1 with fytolan treatment the number of fungal species remained the same.

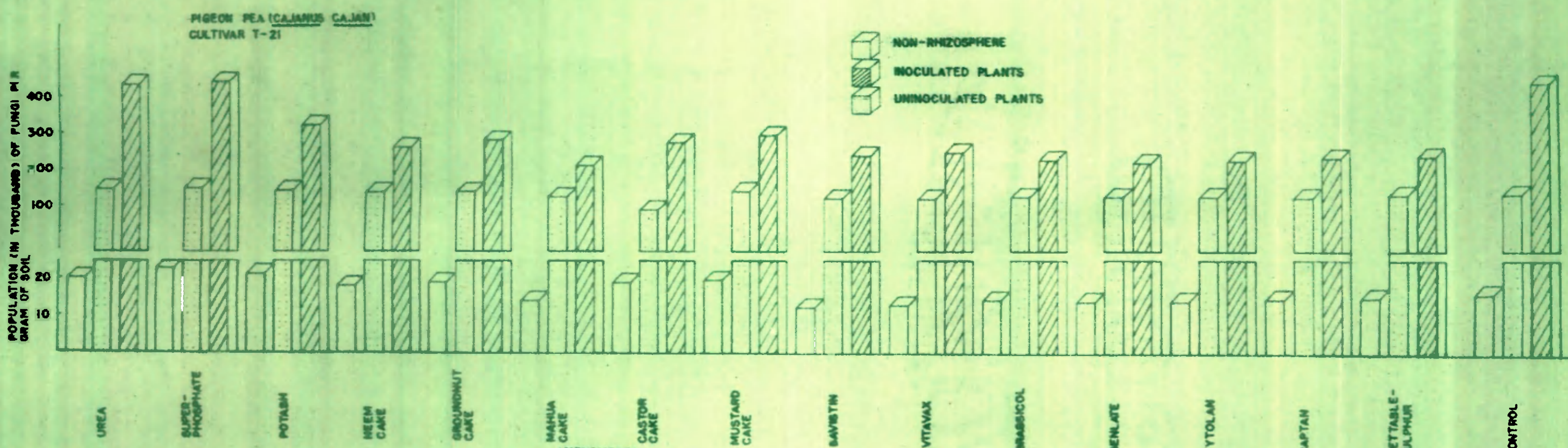
It is clear from table 46 that in the rhizoplane of uninoculated plants of cultivar T-21, the frequency of Aspergillus fumigatus, A. flavus, A. niger, Cephalosporium curtipes, C. roseo-griseum, Gelasinospora cerealis, Trichoderma viride increased in amendments with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake and mustard cake and decreased with bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur. However, the frequency of Aspergillus fumigatus was not affected with fytolan, captan and wettable sulphur; Cephalosporium roseo-griseum with benlate, fytolan, captan and wettable sulphur. The frequency of Rhizopus oryzae increased with urea, superphosphate, potash, neem cake and mahua cake amendments and decreased in the rest of the treatments, however, no change was observed with groundnut cake and castor cake; Neocosmospora vasinfecta increased with urea, superphosphate, potash, neem cake, groundnut cake, mustard cake, brassicol, benlate, captan and wettable sulphur and decreased in vitavax, however, no change was noticed in the rest of the treatments; Chaetomium magnum increased with urea, superphosphate, potash, neem cake, groundnut cake, captan and wettable sulphur and decreased in bavistin, vitavax, benlate, however, no change was recorded in rest of the treatments. The frequency of Phoma hibernica, Drechslera *australiensis*, *Curvularia pallescens*, and *Cladosporium herbarum* increased in urea and superphosphate and decreased in the rest of the treatments. Fungi like *Cunninghamella echinulata* and *Mucor globosus* appeared in the rhizoplane of uninoculated plants in amendments with neem cake, groundnut cake, mahua cake, castor cake and mustard cake, though were absent in control. Similarly *Monosporium olivaceum* was recorded in treatments with mahua cake and castor cake. On the other hand, *Aspergillus terreus* was completely eliminated in amendments with bavistin, vitavax, benlate; *A. candidus* with bavistin, vitavax, brassicol and benlate; *A. terricola* with bavistin, vitavax, brassicol, benlate and fytolan; *Phoma hibernica* with bavistin, vitavax and benlate; *Cephalosporium roseo-griseum* with bavistin and vitavax. In the rhizoplane of inoculated plants the frequency of *Rhizopus oryzae*, *Aspergillus fumigatus*, *A. flavus*, *A. niger*, *Gelasinospora cerealis* increased in all the treatments. However, the frequency of *Pyrenochaeta cajani*, *Phoma hibernica*, *Chaetomium magnum*, *Fusarium udum*, *Drechslera australiensis*, *Curvularia pallescens*, *Alternaria alternata*, *Helminthosporium sativum*, *Cladosporium herbarum*, *Rhizoctonia solani*, *Sclerotium rolfsii* and yellow sterile mycelium increased in urea and superphosphate treatments and decreased in the rest of the treatments. *Mortierella alpina* appeared in all the treatments except bavistin, captan and wettable sulphur, though absent in control; *Circinella tenella*, *Cephalosporium curtipes*, *C. roseo-griseum* appeared in treatments with neem cake, groundnut cake, mahua cake, castor cake and mustard cake; Aspergillus terreus, A. candidus, A. terricola in urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake and mustard cake treatments; Trichoderma viride in neem cake, groundnut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax and benlate. However, Cunninghamella echinulata was completely eliminated with bavistin, vitavax treatments; Mucor racemosus in mahua cake; Pyrenochaeta cajani in neem cake, castor cake, bavistin, vitavax and benlate; Phoma hibernica in bavistin, vitavax and benlate; Fusarium udum in neem cake, mahua cake, castor cake, bavistin and vitavax; Alternaria alternata, Helminthosporium sativum and Rhizoctonia solani in castor cake; Sclerotium rolfsii in neem cake, mahua cake and castor cake.

A perusal of table 48 reveals that in the rhizoplane of uninoculated plants of cultivar BDN-1, the frequency of Rhizopus oryzae, R. nigricans, Syncephalastrum racemosum, Aspergillus fumigatus, A. flavus, A. niger, A. terreus, A. candidus, A. ustus, A. terricola, Chaetomium magnum, Cephalosporium curtipes, C. roseo-griseum, Monilia brunnea, Gelasinospora cerealis, Trichoderma viride and black sterile mycelium increased in amendments with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake and mustard cake and decreased in bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur. However, the frequency of *Phoma hibernica*, *Drechslera australiensis* and *Cladosporium herbarum* increased in treatments with urea and superphosphate and decreased in the rest of the treatments. *Phoma hibernica* was completely eliminated in treatments with neem cake, groundnut cake, mahua cake, castor cake and mustard cake. In the rhizoplane of inoculated plants, the frequency of *Aspergillus fumigatus*, *A. flavus*, *A. niger*, *A. candidus*, *A. ustus*, *Monilia brunnea*, *Gelasinospora cerealis* and *Trichoderma viride* increased in amendments with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake and mustard cake and decreased in the rest of the treatments. However, the frequency of *Aspergillus fumigatus* was not affected by benlate, fytolan, captan and wettable sulphur treatments; *A. flavus* brassicol, benlate, fytolan, captan and wettable sulphur; *A. candidus*, benlate and fytolan. Frequency of *Aspergillus niger* was not affected with vitavax and brassicol and increased with benlate, fytolan, captan and wettable sulphur. Frequency of *Trichoderma viride* remained unaffected with wettable sulphur and bavistin and increased with vitavax, brassicol, benlate, fytolan, captan and wettable sulphur. The frequency of *Cunninghamella echinulata* and *Mucor mucedo* did not change with urea amendments and increased with superphosphate, and decreased with rest of the treatments. The frequency of *Pyrenochaeta cajani*, *Phoma* hibernica, Monosporium olivaceum, Fusarium udum, Drechslera australiensis, Alternaria alternata, Helminthosporium sativum, Cladosporium herbarum, Rhizoctonia solani and Sclerotium rolfsii increased with urea and super phosphate treatments and decreased in rest of the treatments. Syncephalastrum racemosum, Aspergillus terricola, Cephalosporium curtipes, and C. roseo-griseum appeared in the oil cakes treatments; A. terreus appeared in urea, superphosphate, potash and oil cake amendments. On the other hand, Pyrenochaeta cajani was completely eliminated with oil cake amendments and fungicidal treatments except captan and wettable sulphur; Phoma hibernica in oil cake amendments; Fusarium udum in potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, benlate and fytolan; Rhizoctonia solani and Sclerotium rolfsii in all oil cake amendments.

In the rhizosphere and rhizoplane of uninoculated plants of cultivar T-21, the frequency of majority of saprophytic fungi was found higher in comparison to the parasitic forms in all the treatments. However, in the inoculated plants reverse trend was noticed in only urea and superphosphate treatments (Table 45 and 46). Similarly in the rhizosphere and rhizoplane of uninoculated plants of cultivar BDN-1, the frequency of majority of saprophytic fungi was observed higher in comparison to most of the parasitic forms. However, a reverse trend was observed in the inoculated plants with only superphosphate amendment (Table 47 and 48).

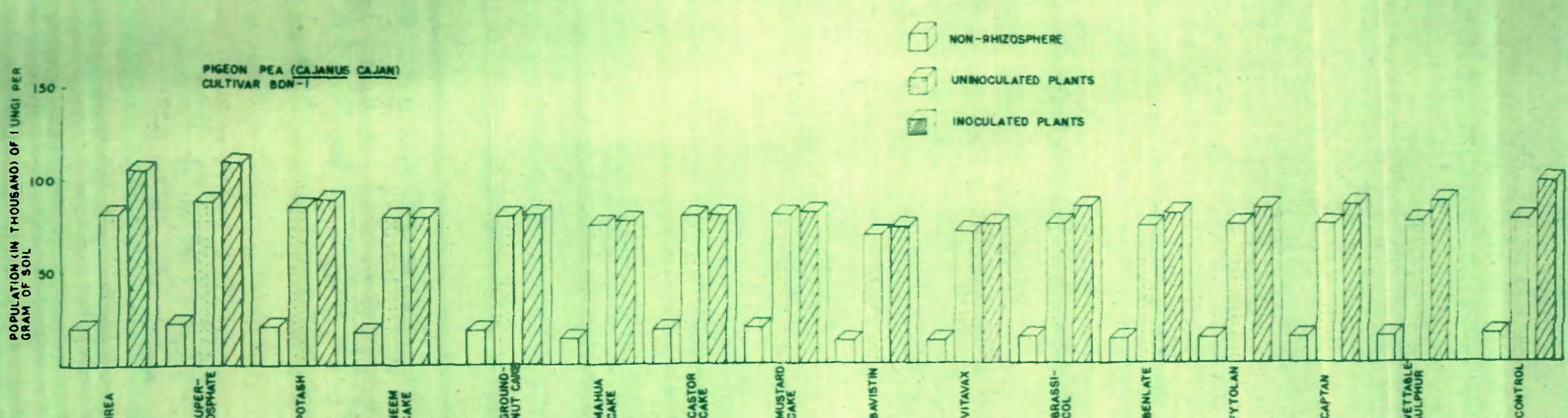
On the basis of above results it is concluded that in the rhizosphere of uninoculated plants of cultivars T-21 and BDN-1 and in the non-rhizosphere soil, amendments with urea, superphosphate, potash, neem cake, groundnut cake, castor cake and mustard cake showed stimulatory effect; however, mahua cake, bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur showed inhibitory effect. On the other hand, the stimulatory effect was noticed in treatments with only urea and superphosphate in the rhizosphere of inoculated plants of both the cultivars, however, rest of the treatments showed inhibitory effect. Effect of soil amendments was significant at 5% and 1% level in all the treatments except with wettable sulphur in uninoculated plants of BDN-1. Higher population of fungi was recorded in the rhizosphere of inoculated plants of both the cultivars in all the amendments in comparison to their uninoculated counterparts. The frequency of most of the saprophytic forms in the rhizosphere and rhizoplane of uninoculated plants of cultivar T-21 and BDN-1 and in non-rhizosphere increased in treatments with urea, superphosphate, neem cake, groundnut cake, mahua cake, castor cake, and mustard cake and decreased in all the fungicidal treatments in comparison to control; however, majority of parasitic forms increased in only urea and superphosphate and decreased in the rest of the treatments. In the rhizosphere and rhizoplane of inoculated plants of cultivar T-21, the frequency of most of the saprophytic fungi increased in all the treatments; however, in case of cultivar BDN-1 the frequency increased in the treatments with urea, superphosphate, potash and oil cake amendments, and either decreased or increased in fungicidal treatments. On the other hand, the frequency of majority of parasitic fungi, in the rhizosphere and rhizoplane of T-21 and BDN-1, increased in the treatments with urea and superphosphate and decreased with rest of the treatments. In the rhizosphere and rhizoplane of T-21, Fusarium udum was completely eliminated in the treatments with neem cake, mahua cake, castor cake, bavistin, vitavax and benlate; however in the rhizosphere and rhizoplane of cultivar BDN-1, it was completely eliminated in the treatments with potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, brassicol, benlate and fytolan. The frequency of majority of saprophytic fungi was found higher in comparison to most of the parasitic forms, in all the treatments, in the rhizosphere and rhizoplane of uninoculated plants of cultivar T-21; however, in the inoculated plants a reverse trend was noticed in only urea and superphosphate treatments. Similarly, in the rhizosphere and rhizoplane of uninoculated plants of cultivar BDN-1, the frequency of majority of saprophytic fungi was observed higher in comparison to most of the parasitic forms; however, a reverse trend was observed in the inoculated plants with only superphosphate amendment.

FIG. 5. Population of fungi in the non-rhizosphere, rhizosphere of uninoculated and inoculated plants of pigeon pea cultivar T-21 (with *Fusarium udum* Butler) treated with different soil amendments.



AMENDMENTS
FIG. 5

FIG. 6. Population of fungi in the non-rhizosphere, rhizosphere of uninoculated and inoculated plants of pigeon pea cultivar BDN-1 (with *Fusarium udum* Butler) treated with different soil amendments.



AMENDMENTS

FIG.6

TABLE 43. Population of fungi (per gram of soil) in the non-rhizosphere and rhizosphere of uninoculated and inoculated plants of pigeon pea (cultivars T-21 and BDN-1) with *F. udum* under different soil amendments.

Amendments	Non-rhizosphere (S)	Rhizosphere (R)							
		T - 21				BDN - 1			
		Uninoculated plants	R:S ratio	Inoculated plants	R:S ratio	Uninoculated plants	R:S ratio	Inoculated plants	R:S ratio
Control	16*	130	8.12	428	26.75	79	4.93	100	6.25
Urea	20.3	140.5	6.92	432	21.28	82	4.03	106	5.22
Superphosphate	22.8	148	7.29	440	19.29	89	3.90	110	4.82
Potash (Muriate of potash)	21.1	143	6.77	320	15.16	86	4.07	90	4.26
Neem cake	18	136	7.55	260	14.44	80.5	4.47	80.9	4.49
Groundnut cake	19	139	7.31	280	14.73	81	4.26	82	4.31
Mahua cake	14	123	8.78	210	15.00	76	5.42	78	5.57
Castor cake	18.8	136.5	7.23	270	14.36	80.7	4.29	81.1	4.31
Mustard cake	19.5	139.8	7.16	290	14.87	81.9	4.20	83	4.25
Bavistin	12.3	118.3	9.61	185	15.04	71	5.77	75	6.09
Vitavax	12.9	119.2	9.24	192	14.88	72.2	5.59	76.2	5.90
Brassicol	14.2	123.8	8.71	222	15.63	76.9	5.41	86.1	6.06
Benlate	13.9	122.95	8.84	215	15.46	75.8	5.45	83	5.97
Fytolan	14	123.2	8.80	220	15.71	76.5	5.46	85.5	6.10
Captan	14.5	124	8.55	226	15.58	77.2	5.32	87.3	6.02
Wettable sulphur	15	127	8.46	230	15.33	78	5.20	89	5.93
L.S.D. at 5%	0.58593	0.76480		1.11845		1.02807		0.51050	
L.S.D. at 1%	0.78909	1.02998		1.50624		1.38452		0.68750	

*in thousand.

TABLE 44. Frequency (percentage) of fungi in the non-rhizosphere under different soil amendments.

Fungi isolated	Amendments															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Rhizopus oryzae Went & Gerlings	20*	25	35	30	25	30	25	25	30	10	15	20	15	20	20	20
Cunninghamella echinulata Thaxter	25	30	40	40	30	30	30	25	30	10	15	20	15	20	20	25
Aspergillus fumigatus Fresenius	40	50	60	55	70	75	45	75	75	30	35	35	35	35	40	40
A. flavus Link	45	50	60	55	75	75	50	70	75	40	40	40	40	40	45	45
A. niger van Tieghem	30	35	45	45	60	65	35	60	65	30	30	30	25	25	25	30
A. luchuensis Inui	20	30	40	40	55	55	25	55	60	15	15	20	20	20	20	20
A. terreus Thom	30	40	50	45	50	50	35	50	55	20	25	25	25	25	30	30
A. ochraceous Wilhelm	25	30	40	35	45	45	30	50	45	20	20	20	20	25	25	25
A. nidulans (Eidam) Winter	20	25	35	30	40	50	25	45	40	15	15	15	15	15	20	20
Pyrenochaeta cajani Singh & Pavgi	10	40	65	5	5	5	5	5	5	-	-	5	5	10	10	10
Phoma hibernica Grimes, O'Connors and Cummins	15	45	70	5	5	5	5	5	5	5	5	10	10	10	10	15
Cephalosporium curtipes Saccardo	25	30	40	40	60	65	30	65	60	15	15	20	20	20	25	25
C. asperum Marchal	10	15	30	25	40	45	15	45	35	5	-	5	-	5	5	5
Monilia geophila Cudemans	30	35	45	40	50	50	35	50	55	25	25	25	25	25	25	25
M. brunnea Gilman & Abbott	15	20	40	30	50	50	20	55	50	5	5	10	10	10	15	15
Fusidium viride Grove	15	25	35	35	35	35	20	35	35	5	10	10	10	10	15	15
Fusarium oxysporum Schlecht	20	45	65	10	10	10	5	10	15	5	5	10	5	10	10	15
Drechslera australiensis Subram.& Jain ex.M.B. Ellis	15	30	50	10	10	10	5	10	10	-	5	10	5	5	10	15
Curvularia pallescens Boedijn	30	40	65	15	10	10	5	15	20	5	5	10	10	15	20	25
Alternaria alternata (Fr.) Keissler	20	30	60	15	10	10	5	10	15	5	5	10	10	15	15	15
Cladosporium herbarum (Persoon) Link	20	25	50	15	10	10	5	10	15	5	5	10	10	10	20	20
White sterile mycelium	25	30	45	50	60	65	30	55	55	10	10	15	10	20	25	25

*Calculated on the basis of 20 replicates.

1 = Control; 2 = Urea; 3 = Superphosphate; 4 = Potash; 5 = Neem cake; 6 = Groundnut cake; 7 = Mahua cake; 8 = Castor cake; 9 = Mustard cake; 10 = Bavistin; 11 = Vitavax; 12 = Brassicol; 13 = Benlate; 14 = Fytolan; 15 = Captan; 16 = Wettable sulphur.

TABLE 47. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plant cultivar BDN-1 uninoculated and inoculated with F. udum under different soil amendments.

Fungi isolated	Amendments																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP
Rhizopus oryzae Went & Gerlings	20*	-	30	-	35	-	30	25	25	25	25	25	25	25	30	25	25	25	10	-	10	-	10	-	10	-	15	-	15	-	20	-
R. nigricans Ehrenberg	10	15	15	10	20	10	15	15	20	20	15	15	15	20	15	10	20	20	5	10	5	10	5	5	5	5	5	10	10	15	10	15
Cunninghamella echinulata Thaxter	-	25	-	25	-	30	-	20	5	5	10	10	15	10	10	10	15	15	-	5	-	15	-	15	-	10	-	10	-	15	-	20
C. bertholletae Stadel	15	20	20	15	25	15	25	20	10	15	10	15	15	15	10	10	10	15	10	15	10	10	15	15	10	10	15	15	10	15	15	20
Mucor mucedo (Linne) Brefeld	-	10	-	10	-	15	-	5	5	5	5	5	10	10	5	10	5	5	-	5	-	5	-	5	-	5	-	5	-	10	-	10
Syncephalastrum racemosum (Cohn) Schroeter	25	-	30	-	40	-	35	30	40	35	35	35	40	40	40	40	35	35	10	-	10	-	10	-	10	-	15	-	20	-	20	-
Aspergillus fumigatus Frasenius	85	70	90	80	95	75	95	90	100	100	100	100	100	100	100	95	100	100	50	55	50	50	55	65	60	65	60	60	70	60	80	65
A. funiculosus G. Smith	10	10	15	10	30	15	20	15	30	35	30	30	25	25	25	30	25	35	-	-	-	-	-	5	-	5	-	5	5	-	5	-
A. flavus Link	70	55	75	60	85	60	80	80	95	95	90	95	80	80	80	85	85	80	45	50	45	55	50	55	50	50	55	55	60	50	65	55
A. niger van Tieghem	60	40	65	55	75	40	70	65	70	75	70	75	60	60	65	65	60	65	45	30	45	40	50	50	45	45	50	50	55	40	55	45
A. terreus Thom	30	-	35	25	40	30	40	35	40	45	40	35	40	40	40	45	45	40	10	-	10	-	15	-	15	-	15	-	20	-	25	-
A. candidus Link	25	25	30	20	35	20	35	35	35	35	35	40	35	35	30	35	30	35	10	20	15	20	20	20	20	25	20	25	20	15	25	15
A. ustus (Bainier) Thom & Church	10	15	15	10	20	10	20	20	25	25	20	25	30	25	25	30	25	30	5	10	10	10	10	10	10	10	10	10	10	5	10	5
A. terricola Marchal	10	-	15	-	25	-	20	15	15	15	15	15	15	20	15	20	20	20	-	-	-	-	-	-	-	-	5	-	5	-	10	-
A. sydowi (Bainier & Sartory) Thom & Church	15	-	15	-	20	-	20	15	20	20	20	20	20	15	15	15	15	15	5	-	5	-	5	-	10	-	10	-	10	-	10	-
Penicillium chrysogenum Thom	20	-	25	-	30	-	20	15	30	30	25	25	25	20	20	25	25	25	10	-	10	-	10	-	10	-	10	-	15	-	15	-
Pyrenochaeta cajani Singh & Pavgi	-	10	-	15	-	25	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	5
Phoma hibernica Grimes, O'Connor & Cummins	10	15	15	20	20	40	15	10	-	-	-	-	-	-	-	-	-	-	5	5	5	5	5	10	5	5	10	10	10	15	10	15
Chaetomium magnum Bainier	10	15	20	25	25	35	20	15	15	15	20	20	25	20	20	20	20	20	5	5	5	5	5	10	5	5	5	10	10	15	10	15
Gelasinospora cerealis Dowding	10	10	15	10	25	10	20	15	25	30	30	35	20	20	20	25	25	25	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Cephalosporium curtipes Saccardo	40	-	45	-	60	-	55	20	70	75	75	75	65	60	65	70	70	65	15	-	15	-	20	-	20	-	25	-	25	-	30	-
C. roseo-griseum Saksena	10	-	15	-	30	-	25	10	35	30	30	30	25	30	30	35	35	35	5	-	5	-	5	-	5	-	5	-	5	-	5	-
Monilia brunnea Gilman & Abbott	20	10	25	10	30	10	30	15	20	15	20	25	25	20	25	25	25	20	10	5	10	10	10	10	15	10	5	5	10	5	15	10
Monosporium olivaceum Cooke & Massee	-	20	-	25	-	30	-	10	5	5	5	5	5	10	10	5	10	5	-	10	-	10	-	10	-	10	-	10	-	10	-	15
Trichoderma viride Pers. ex Fr.	20	5	25	10	35	5	35	20	50	50	50	50	45	40	40	45	45	45	5	-	10	-	15	-	15	-	15	-	10	5	15	-
T. lignorum (Tode) Harz	15	10	20	5	25	-	20	15	30	35	40	35	30	25	25	25	25	20	5	5	5	5	10	5	5	5	5	5	10	-	10	-
T. album Preuss	5	-	10	-	15	-	15	15	25	20	25	25	20	20	20	20	20	25	-	-	-	-	-	-	-	-	-	-	5	-	5	-
Fusarium udum Butler	-	30	-	40	-	55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	20
F. oxysporum Schlecht	15	20	20	25	30	40	10	10	5	5	5	5	5	10	5	5	5	5	-	5	-	5	-	5	5	-	5	-	5	10	5	10
Fusidium viride Grove	15	-	20	-	40	-	40	25	40	40	40	45	35	40	40	45	40	45	5	-	10	-	10	-	10	-	10	-	10	-	10	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	20	25	25	30	30	50	10	10	5	5	5	5	10	10	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	10	5	15
Curvularia pallescens Boedijn	40	45	45	50	55	70	35	40	15	15	15	15	15	15	20	20	15	20	20	25	20	25	20	25	20	20	25	20	25	35	30	40
Alternaria alternata (Fr.) Keissler	-	15	-	20	-	35	-	5	5	5	5	5	5	10	10	5	10	10	-	5	-	5	-	5	-	5	-	10	-	10	-	10
Helminthosporium sativum Pammel, King & Bakke	-	15	-	20	-	30	-	5	10	10	10	10	10	10	10	10	10	10	-	5	-	5	-	5	-	5	-	5	-	5	-	5
Cladosporium herbarum (Persoon) Link	15	20	15	25	25	45	5	-	10	10	10	10	10	10	10	10	10	10	5	5	5	5	5	5	5	5	5	10	5	10	10	15
Hormiscium stilbosporum (Corda) Saccardo	-	15	-	20	-	25	-	5	5	5	5	5	5	5	5	5	5	5	-	-	-	-	-	-	-	-	-	-	-	5	-	5
Rhizoctonia solani Kuhn	-	20	-	25	-	40	-	10	-	-	-	-	-	-	-	-	-	-	-	5	-	5	-	5	-	5	-	5	-	10	-	10
Sclerotium rolfsii Saccardo	-	15	-	20	-	35	-	5	-	-	-	-	-	-	-	-	-	-	-	5	-	5	-	5	-	5	-	5	-	10	-	10
White sterile mycelium	15	-	20	-	30	-	30	20	30	25	25	25	20	20	25	30	30	35	5	-	5	-	10	-	10	-	10	-	10	-	15	-
Black sterile mycelium	10	-	20	-	25	-	25	15	30	30	25	25	15	15	30	30	25	25	5	-	5	-	10	-	10	-	10	-	5	-	10	-

*Calculated on the basis of 20 replicates.

1 = Control; 2 = Urea; 3 = Superphosphate; 4 = Potash; 5 = Neem cake; 6 = Groundnut cake; 7 = Mahua cake; 8 = Castor cake;
9 = Mustard cake; 10 = Bavistin; 11 = Vitavax; 12 = Brassicol; 13 = Benlate; 14 = Fytolan; 15 = Captan; 16 = Wettable sulphur.

UP = Uninoculated plants; IP = Inoculated plnts.

TABLE 46. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants cultivar T-21 uninoculated and inoculated with F. udum under different soil amendments.

Fungi isolated	Amendments 1 UP	1 IP	2 UP	2 IP	3 UP	3 IP	4 UP	4 IP	5 UP	5 IP	6 UP	6 IP	7 UP	7 IP	8 UP	8 IP
Rhizopus oryzae Went & Gerlings	30*	15	35	25	40	30	35	30	35	35	30	25	35	40	30	30
Cunninghamella echinulata Thaxter	-	10	-	15	-	25	-	20	5	5	5	5	10	10	10	10
Mucor globosus Fischer	-	5	-	10	-	20	-	25	5	5	5	5	10	10	15	15
M. racemosus Fresenius	-	10	-	15	-	25	-	20	-	10	-	10	-	-	-	10
Mortierella alpina Peyroud	20	-	25	15	30	25	25	25	20	15	20	15	15	20	20	25
Circinella tenella (Ling-Young) Zycha	40	-	45	-	50	-	45	-	45	15	45	10	30	10	45	15
Aspergillus fumigatus Fresinius	60	30	65	40	70	50	65	60	90	85	80	75	70	70	90	100
A. flavus Link	55	15	60	30	70	40	60	45	70	65	65	60	55	50	70	70
A. niger van Tieghem	40	15	45	30	50	35	45	40	60	60	50	50	40	45	50	50
A. terreus Thom	30	-	40	20	45	30	40	30	50	55	45	40	35	35	45	40
A. candidus Link	25	-	30	15	35	25	30	25	45	40	40	35	25	25	40	40
A. terricola Marchal	20	-	30	20	35	25	30	25	40	35	35	35	20	15	35	35
Pyrenochaeta cajani Singh & Pavgi	-	50	-	60	-	70	-	30	-	-	-	10	-	5	-	-
Phoma hibernica Grimes, O'Connor & Cummins	20	35	25	40	30	50	10	20	5	5	10	10	10	10	5	5
Neocosmospora vasinfecta E.F. Smith	10	-	15	-	25	-	20	-	20	-	20	-	10	-	10	10
Chaetomium magnum Bainier	15	35	25	40	30	45	30	35	25	20	25	20	15	20	15	15
Gelasinospora cerealis Dowding	30	10	40	20	45	25	40	30	50	50	45	35	30	35	45	45
Cephalosporium curtipes Saccardo	20	-	25	-	35	-	30	-	45	50	35	30	25	20	45	40
C. roseo-griseum Saksena	10	-	15	-	25	-	20	-	35	30	25	25	20	15	30	35
Monosporium olivaceum Cooke & Massee	-	20	-	25	-	35	-	30	-	20	-	20	5	25	15	20
Trichoderma viride Pers. ex Fr.	35	-	40	-	45	-	45	-	70	70	40	30	30	35	75	75
Fusarium udum Butler	-	100	-	100	-	100	-	55	-	-	-	15	-	-	-	-
Drechslera australiensis Subram. & Jain ex M.B. Ellis	15	35	20	40	30	50	10	20	10	10	10	15	5	5	5	5
Curvularia pallescens Boedijn	15	40	20	45	30	55	10	25	5	10	5	20	5	5	5	5
Alternaria alternata (Fr.) Keissler	-	40	-	45	-	55	-	25	-	10	-	20	-	10	-	-
Helminthosporium sativum Pammel, King & Bakke	-	20	-	25	-	30	-	10	-	5	-	20	-	10	-	-
Cladosporium herbarum (Persoon) Link	20	40	30	35	35	45	10	25	10	15	15	20	15	10	10	10
Rhizoctonia solani Kuhn	-	40	-	45	-	50	-	20	-	5	-	10	-	5	-	-
Sclerotium rolfsii Saccardo	-	15	-	25	-	30	-	10	-	-	-	5	-	-	-	-
Yellow sterile mycelium	-	20	-	25	-	30	-	25	-	-	-	10	-	5	-	5
Black sterile mycelium	30	-	40	-	45	-	45	-	55	55	30	10	35	30	20	25

Fungi isolated	9 UP	9 IP	10 UP	10 IP	11 UP	11 IP	12 UP	12 IP	13 UP	13 IP	14 UP	14 IP	15 UP	15 IP	16 UP	16 IP
Rhizopus oryzae Went & Gerlings	25	25	15	15	15	15	20	15	20	20	25	20	25	20	25	25
Cunninghamella echinulata Thaxter	10	10	-	-	-	-	-	5	-	15	-	15	-	15	-	10
Mucor globosus Fischer	15	15	-	5	-	10	-	10	-	15	-	20	-	15	-	10
M. racemosus Fresenius	-	15	-	5	-	10	-	10	-	15	-	15	-	10	-	10
Mortierella alpina Peyroud	25	20	10	-	10	10	10	10	10	15	10	10	10	-	15	-
Circinella tenella (Ling-Young) Zycha	30	10	15	-	15	-	20	-	15	-	20	-	20	-	25	-
Aspergillus fumigatus Fresinius	80	75	50	55	45	50	55	50	55	60	60	55	60	45	60	40
A. flavus Link	65	55	50	55	50	50	45	35	50	55	50	45	45	30	50	25
A. niger van Tieghem	55	45	30	30	30	30	30	25	25	30	35	30	35	25	35	20
A. terreus Thom	40	30	-	-	-	-	10	-	-	-	15	-	15	-	20	-
A. candidus Link	40	30	-	-	-	-	-	-	-	-	10	-	10	-	10	-
A. terricola Marchal	45	35	-	-	-	-	-	-	-	-	-	-	10	-	10	-
Pyrenochaeta cajani Singh & Pavgi	-	15	-	-	-	-	-	15	-	-	-	25	-	30	-	30
Phoma hibernica Grimes, O'Connor & Cummins	10	15	-	-	-	-	5	10	-	-	10	20	15	20	15	20
Neocosmospora vasinfecta E.F. Smith	15	-	5	5	10	10	15	-	15	-	10	-	20	-	20	-
Chaetomium magnum Bainier	15	25	10	10	10	10	15	20	10	15	15	20	20	25	20	25
Gelasinospora cerealis Dowding	45	30	15	15	15	15	15	15	25	25	25	20	25	15	25	15
Cephalosporium curtipes Saccardo	35	30	10	10	10	10	15	5	15	5	15	-	15	-	15	-
C. roseo-griseum Saksena	25	15	-	-	-	-	5	-	10	10	10	-	10	-	10	-
Monosporium olivaceum Cooke & Massee	-	15	-	10	-	15	-	20	-	20	-	25	-	25	-	25
Trichoderma viride Pers. ex Fr.	35	25	20	20	20	20	15	-	20	25	25	-	25	-	25	-
Fusarium udum Butler	-	20	-	-	-	-	-	20	-	5	-	30	-	40	-	50
Drechslera australiensis Subram. & Jain ex M.B. Ellis	-	5	5	10	5	10	10	20	5	15	10	20	10	25	10	25
Curvularia pallescens Boedijn	5	20	5	15	5	15	10	25	5	15	5	20	10	30	10	30
Alternaria alternata (Fr.) Keissler	-	20	-	5	-	5	-	15	-	10	-	15	-	20	-	20
Helminthosporium sativum Pammel, King & Bakke	-	15	-	5	-	5	-	10	-	10	-	10	-	15	-	15
Cladosporium herbarum (Persoon) Link	15	20	5	5	5	5	10	15	10	10	10	20	15	25	15	30
Rhizoctonia solani Kuhn	-	10	-	5	-	5	-	10	-	5	-	10	-	15	-	15
Sclerotium rolfsii Saccardo	-	5	-	5	-	5	-	10	-	5	-	10	-	10	-	10
Yellow sterile mycelium	-	5	-	5	-	5	-	10	-	5	-	10	-	10	-	15
Black sterile mycelium	25	10	10	-	10	-	20	-	20	-	25	-	25	-	25	-

*Calculated on the basis of 20 replicates.

1 = Control; 2 = Urea; 3 = Superphosphate; 4 = Potash; 5 = Neem cake; 6 = Groundnut cake; 7 = Mahua cake; 8 = Castor cake
9 = Mustard cake; 10 = Bavistin; 11 = Vitavax; 12 = Brassicol; 13 = Benlate; 14 = Fytolan; 15 = Captan; 16 = Wettable sulphur.

UP = Uninoculated plants. IP = Inoculated plants.

TABLE 45. Frequency (percentage) of fungi in the rhizosphere of pigeon pea plants cultivar T-21 uninoculated and inoculated with *F. udum* under different soil amendments.

Fungi isolated	Amendments 1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP
Rhizopus oryzae Went & Gerlings	20*	10	30	25	35	30	30	25	25	25	25	30	25	30	25	25	20	20	10	10	10	10	15	10	15	15	20	15	20	15	20	20
Cunninghamella echinulata Thaxter	-	10	-	15	-	20	-	15	5	5	5	5	5	5	5	5	5	5	-	-	-	-	-	5	-	10	-	10	-	10	-	5
Mucor globosus Fischer	-	20	-	25	-	30	-	25	5	5	5	5	5	5	10	10	10	10	-	5	-	5	-	5	-	10	-	15	-	10	-	5
M. racemosus Fresenius	-	15	-	20	-	25	-	20	-	5	-	5	-	-	-	5	-	10	-	5	-	5	-	5	-	10	-	10	-	5	-	5
Mortierella alpina Peyroud	10	20	20	15	30	20	25	15	20	15	20	15	10	10	15	20	20	15	5	-	5	5	5	5	5	10	5	5	5	-	10	-
Circinella tenella (Ling-Young) Zycha	20	-	30	-	35	-	35	-	30	10	25	5	15	5	30	5	25	5	15	-	10	-	15	-	10	-	15	-	15	-	15	-
Aspergillus fumigatus Fresenius	60	30	70	60	75	65	75	70	80	85	75	70	65	60	80	85	75	70	40	45	40	45	50	45	50	55	55	50	55	40	55	40
A. funiculosus G. Smith	25	10	35	20	40	35	40	35	40	40	40	30	25	25	40	35	40	30	10	15	10	15	20	15	15	20	20	15	20	10	20	10
A. flavus Link	50	20	60	40	65	60	60	55	70	65	65	60	45	50	65	65	60	50	40	45	45	45	40	35	45	50	45	40	45	30	45	30
A. niger van Tieghem	30	10	35	20	40	35	35	30	50	50	45	45	35	35	50	50	50	45	25	25	25	25	25	20	20	20	30	25	30	25	30	20
A. luchuensis Inui	10	-	25	20	35	20	30	25	25	20	20	15	10	15	20	25	20	15	-	-	-	-	5	-	-	-	5	-	5	-	10	-
A. terreus Thom	20	-	45	25	50	30	45	40	35	35	30	30	25	25	40	35	35	30	-	-	-	-	10	-	-	-	10	-	10	-	15	-
A. nidulans (Eidam) Winter	10	-	20	15	25	20	25	20	30	30	30	30	15	20	30	30	30	30	-	-	-	-	5	-	-	-	5	-	5	-	10	-
A. candidus Link	10	-	25	20	30	25	30	25	35	35	35	30	15	15	35	35	35	30	-	-	-	-	-	-	-	-	5	-	5	-	5	-
A. terricola Marchal	10	-	20	10	25	15	25	20	40	35	40	40	15	10	35	35	40	35	-	-	-	-	-	-	-	-	-	-	5	-	5	-
Pyrenochaeta cajani Singh & Pavgi	-	30	-	35	-	40	-	20	-	-	-	10	-	5	-	-	-	15	-	-	-	-	-	15	-	-	-	20	-	25	-	25
Phoma hibernica Grimes, O'Connor & Cummins	20	40	30	45	40	45	20	25	5	5	10	10	10	10	5	5	10	10	-	-	-	-	5	10	-	-	5	15	10	15	15	15
Neocosmospora vasinfecta E.F. Smith	20	-	30	-	40	-	10	-	10	-	10	-	15	-	10	10	15	-	5	5	10	10	15	-	10	-	15	-	15	-	15	-
Chaetomium magnum Bainier	20	30	30	40	35	50	15	20	15	20	20	25	20	30	20	25	15	25	10	10	10	10	15	20	5	10	15	20	15	20	15	20
Gelasinospora cerealis Dowding	30	10	40	20	45	25	35	20	40	40	40	30	25	30	40	40	40	30	10	10	10	10	10	10	20	20	20	15	20	10	20	10
Cephalosporium curtipes Saccardo	15	-	25	-	30	-	30	-	40	45	30	25	20	20	40	35	30	25	5	5	5	5	10	-	15	-	10	-	10	-	10	-
C. roseo-griseum Saksena	10	-	25	-	30	-	30	-	30	35	20	20	15	10	25	30	20	15	-	-	-	-	5	-	5	5	5	-	5	-	5	-
Sporotrichum olivaceum Cook & Massee	-	15	-	20	-	30	-	10	5	15	-	15	5	25	10	15	[illegible]	15	-	5	-	10	-	15	-	15	-	20	-	20	-	20
Trichoderma viride Pers. ex Fr.	25	-	30	-	35	-	40	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Fusarium udum Butler	-	100	-	100	-	100	-	50	-	-	-	10	-	-	-	-	-	15	-	-	-	-	-	15	-	-	-	20	-	30	-	40
F. oxysporum Schlecht	20	30	25	35	40	55	15	25	5	-	10	20	-	5	-	-	10	20	-	-	-	-	10	20	5	5	15	20	20	25	20	30
Fusidium viride Grove	30	-	35	-	40	-	30	-	50	15	45	-	35	30	50	30	40	-	15	-	15	-	15	-	20	10	20	-	20	-	20	-
Drechslera australiensis Subram.& Jain ex. M.B. Ellis	20	30	30	40	40	60	15	20	5	5	5	10	5	5	5	5	-	15	5	10	10	10	15	20	15	10	15	20	15	20	15	20
Curvularia pallescens Boedijn	30	50	40	45	50	65	25	25	15	5	5	15	5	5	5	5	5	20	10	10	10	10	20	25	15	15	20	25	25	25	25	35
Alternaria alternata (Fr.) Keissler	-	20	-	30	-	40	-	10	-	10	-	15	-	10	-	-	-	15	-	5	-	5	-	15	-	10	-	15	-	15	-	15
Helminthosporium sativum Pammel, King & Bakke	-	15	-	25	-	35	-	5	-	10	-	10	-	10	-	-	-	10	-	5	-	5	-	10	-	10	-	10	-	15	-	15
Cladosporium herbarum (Persoon) Link	20	35	25	40	30	50	15	20	15	10	15	20	5	10	10	10	15	20	5	5	5	5	10	15	10	10	10	20	10	25	10	30
Rhizoctonia solani Kuhn	-	20	-	30	-	45	-	-	-	5	-	10	-	5	-	-	-	10	-	5	-	5	-	10	-	5	-	10	-	15	-	15
Sclerotium rolfsii Saccardo	-	15	-	20	-	40	-	-	-	-	-	5	-	-	-	-	-	10	-	5	-	5	-	10	-	5	-	10	-	10	-	10
Yellow sterile mycelium	-	15	-	20	-	35	-	-	-	-	-	5	-	5	-	5	-	10	-	5	-	5	-	10	-	5	-	10	-	10	-	10
Black sterile mycelium	15	-	30	-	35	-	20	25	50	40	20	5	20	15	15	15	40	-	10	-	10	-	15	-	20	-	10	-	15	-	15	-

*Calculated on the basis of 20 replicates.

1 = Control; 2 = Urea; 3 = Superphosphate; 4 = Potash; 5 = Neem cake; 6 = Groundnut cake; 7 = Mahua cake; 8 = Castor cake; 9 = Mustard cake; 10 = Bavistin; 11 = Vitavax; 12 = Brassicol; 13 = Benlate; 14 = Fytolan; 15 = Captan; 16 = Wettable sulphur.

UP = Uninoculated plants; IP = Inoculated plants.

TABLE 48. Frequency (percentage) of fungi in the rhizoplane of pigeon pea plants cultivar BDN-1 uninoculated and inoculated with *F. udum* under different soil amendments.

Fungi isolated	Amendments																															
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP	UP	IP
Rhizopus oryzae Went & Gerlings	25*	-	35	-	40	-	35	30	30	30	30	30	30	30	35	30	30	30	15	-	15	-	15	-	15	-	20	-	20	-	20	-
R. nigricans Ehrenberg	15	20	20	15	25	15	20	20	25	25	20	20	20	25	20	15	25	25	5	10	5	10	5	5	5	5	5	10	10	15	10	15
Cunninghamella echinulata Thaxter	-	30	-	30	-	35	-	25	10	10	15	15	20	15	15	15	20	20	-	10	-	15	-	15	-	10	-	10	-	15	-	20
Mucor mucedo (Linne) Brefeld	-	15	-	15	-	20	-	10	5	5	5	5	10	10	5	10	5	5	-	5	-	5	-	5	-	5	-	5	-	10	-	10
Syncephalastrum racemosum (Cohn) Schroeter	30	-	35	-	40	-	35	30	40	35	35	35	40	40	40	40	35	35	10	-	10	-	10	-	10	-	15	-	20	-	20	-
Aspergillus fumigatus Fresenius	85	60	100	70	100	60	100	95	100	100	100	100	100	100	100	95	100	100	50	50	50	55	65	55	60	60	60	60	70	60	80	60
A. flavus Link	70	50	85	55	90	50	85	80	95	95	90	95	85	85	85	85	85	80	40	40	40	45	55	50	50	50	55	50	60	50	65	50
A. niger van Tieghem	65	35	75	45	80	40	75	75	75	70	75	70	70	65	70	70	65	70	35	30	35	35	45	35	45	45	50	50	55	40	55	40
A. terreus Thom	35	-	45	20	50	20	45	50	45	50	45	40	40	40	40	45	45	40	15	-	15	-	15	-	15	-	15	-	20	-	25	-
A. candidus Link	35	25	55	20	60	20	55	55	55	55	55	50	50	50	45	50	45	50	15	20	15	20	25	20	20	25	20	25	20	15	25	15
A. ustus (Bainier) Thom & Church	20	20	25	15	30	15	25	25	25	25	20	25	30	25	25	30	25	30	5	10	10	10	15	10	10	10	15	10	15	10	15	5
A. terricola Marchal	15	-	25	-	30	-	30	20	25	30	25	25	25	30	25	30	30	30	-	-	-	-	-	-	-	-	10	-	10	-	10	-
Pyrenochaeta cajani Singh & Pavgi	-	15	-	20	-	30	-	10															-	-	-	-	-	-	-	-		-
Phoma hibernica Grimes, O'Connor & Cummins	20	25	25	30	30	40	10	15	-	-	-	-											5	10	5	5	10	10	10	15	10	15
Chaetomium magnum Bainier	15	20	30	35	35	40	25	25	20	25	25	25	30	25	25	25	25	25	5	5	5	5	5	10	5	5	5	10	10	15	10	15
Gelasinospora cerealis Dowding	20	15	25	20	30	20	25	20	30	25	35	30	25	25	25	25	25	25	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Cephalosporium curtipes Saccardo	55	-	60	-	70	-	60	35	75	75	75	75	65	60	65	70	70	65	20	-	20	-	25	-	25	-	30	-	30	-	35	-
C. roseo-griseum Saksena	15	-	20	-	35	-	25	15	40	45	40	40	35	40	40	40	40	40	5	-	5	-	5	-	5	-	5	-	5	-	10	-
Monilia brunnea Gilman & Abbott	25	15	30	20	35	20	30	20	30	25	30	30	30	25	30	30	30	25	10	5	10	10	10	10	5	10	5	5	10	5	15	10
Monosporium olivaceum Cooke & Massee	-	20	-	25	-	30	-	10	10	10	10	10	10	15	15	10	15	10	-	10	-	10	-	10	-	10	-	10	-	10	-	15
Trichoderma viride Pers. ex Fr.	25	10	30	15	40	15	35	20	50	50	50	50	45	40	40	40	45	45	10	-	15	-	20	-	20	-	20	-	15	5	20	-
Fusarium udum Butler	-	35	-	45	-	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	15	-	25
Drechslera australiensis Cubram.& Jain ex. M.B. Ellis	15	25	20	30	25	40	10	15	5	5	5	5	10	10	5	5	5	5	5	5	5	5	5	10	5	5	5	5	5	10	5	15
Curvularia pallescens Boedijn	15	30	25	35	35	50	10	20	15	15	15	15	15	15	20	20	15	20	20	25	20	25	20	25	20	20	25	20	25	35	30	40
Alternaria alternata (Fr.) Keissler	-	20	-	25	-	35	-	5	-	5	-	5	-	10	-	5	-	10	-	5	-	5	-	5	-	5	-	10	-	10	-	10
Helminthosporium sativum Pammel, King & Bakke	-	20	-	25	-	35	-	5	-	10	-	10	-	10	-	10	-	10	-	5	-	5	-	5	-	5	-	5	-	5	-	5
Cladosporium herbarum (Persoon) Link	15	30	20	35	25	40	10	-	15	15	15	15	15	15	15	15	15	15	10	10	10	10	10	10	10	10	10	15	10	15	15	20
Rhizoctonia solani Kuhn	-	25	-	30	-	45	-	10	-	-	-	-	-	-	-	-	-	-	-	5	-	5	-	5	-	5	-	5	-	10	-	10
Sclerotium rolfsii Saccardo	-	15	-	20	-	35	-	5	-	-	-	-	-	-	-	-	-	-	-	5	-	5	-	5	-	5	-	5	-	10	-	10
Yellow sterile mycelium	-	20	-	25	-	35	-	20	20	20	20	20	15	15	20	20	20	25	-	10	-	10	-	15	-	10	-	10	-	15	-	20
Black sterile mycelium	30	-	35	-	40	-	45	-	45	45	45	45	40	35	40	40	35	35	10	-	15	-	20	-	15	-	15	-	20	-	25	-

*Calculated on the basis of 20 replicates.

1 = Control; 2 = Urea; 3 = Superphosphate; 4 = Potash; 5 = Neem cake; 6 = Groundnut cake; 7 = Mahua cake; 8 = Castor cake;
9 = Mustard cake; 10 = Bavistin; 11 = Vitavax; 12 = Brassicol; 13 = Benlate; 14 = Fytolan; 15 = Captan; 16 = Wettable sulphur.

UP = Uninoculated plants; IP = Inoculated plants.

CHAPTER IV

DISCUSSION

The rhizosphere is a unique habitat with a distinctive microbial complex which differs from that of the root-free soil. The community of rhizosphere is composed mainly of non-pathogenic microorganisms. But the very density and the increased microbial interactions harmful and beneficial - can be especially important for soil-borne pathogens because the disease-producing organism must penetrate the rhizosphere in order to initiate infection. Pigeon pea is an important legume. Wilt of pigeon pea caused by *Fusarium udum* Butler is a soil-borne disease. The disease take a heavy toll of the crop in most of the states of India. *Fusarium udum* is a soil-borne root-infecting pathogen. The information concerning the pigeon pea rhizosphere in relation to wilt disease is rather meagre. The aim of the present investigation has been to study the rhizosphere and rhizoplane mycoflora of pigeon pea plants uninoculated and inoculated with *Fusarium udum*, with a view to understand the ecology and control of *F. udum*, in relation to certain attributes that have recently been assigned to rhizosphere mycoflora.

Studies on rhizosphere and rhizoplane mycoflora of uninoculated and inoculated plants of pigeon pea with *Fusarium* udum at varying age reveal that there has been more fungal population in the rhizosphere of both uninoculated and inoculated plants in comparison to non-rhizosphere (Fig. 1; Table 1). This is understandable as in the rhizosphere there are more secretions from roots which provide a better media for fungal activity. These findings are in agreement with many previous studies (Starkey, 1929 b, 1931 and 1958; Timonin, 1940 a,b; Lochhead, 1959; Maliszewska and Moreau, 1959; Reddy, 1959; Ivarson and Katznelson, 1960; Rouatt and Katznelson, 1961; Zagallo and Bollen, 1962; Rangaswamy and Vasantharajan, 1962; Rovira, 1965; and Singh, 1971). Moreover, higher fungal population has been encountered in the rhizosphere of inoculated plants in comparison to their uninoculated counterparts. This may partly be attributed to the more root excretions in inoculated plants in comparison to uninoculated plants. More fungal population in infected plants has also been reported by the other workers (Agnihothrudu, 1957 a and 1959; Timonin, 1966; Mathur and Chauhan, 1972; Babushkina, 1973; and Rai and Upadhyay, 1980). Wood (1967) reported an increase in amino acids, carbohydrates etc. in the infected plants due to higher metabolic activity, which are probably leached out in the rhizosphere and cause higher rhizosphere effect in the inoculated plants. Collins and Scheffer (1958) and Wu and Scheffer (1962) also observed an increase in metabolic activity (respiratory rate) in the Fusarium infected tomato plants. Wheeler and Hanchey (1968) speculated that the cells which first come in contact with a pathogenic agent generally leak due to loss of semipermeability of membrane. Changes in the biochemical nature of roots have also been noticed in the present studies. As a result higher concentrations of total free amino acids, phenols, o-dihydroxy phenols and sugars have been recorded in the roots of inoculated plants in comparison to uninoculated plants (Table 2). Upadhyay and Rai (1982), however, correlated the increase of fungal population in the wilted plants in comparison to healthy ones due to presence of large number of conidia and propagules of wilt pathogen _Fusarium udum_ in the rhizosphere. Agnihothrudu (1955) also found masses of conidia (both macro and micro) on the stem and also on the wilted branches. This along with higher root secretions may be operative in the present study also.

Age profoundly influences the rhizosphere population, R:S ratio and frequency of fungi in the rhizosphere and rhizoplane of both uninoculated and inoculated plants. In the rhizosphere of both uninoculated and inoculated plants the population of fungi increases with the increase in age of the plant upto 90 days then declines upto 180 days and increases again. Similarly, R:S ratio in the uninoculated plants increases upto 90 days, then declines upto 180 days and increases again. However, in the inoculated plants it increases upto 90 days and decreases upto 120 days, further increases upto 150 days and then declines and increases again in the last. This indicates that in both uninoculated and inoculated plants the first peak of population has been during the highest vegetative growth of the plant and second peak during senescens, however, during the flowering and fruiting the population some what declines. Highest rhizosphere effect has been noticed during senescens i.e. 240 days old plants. These findings are in conformity with Starkey (1929), Parkinson (1957), Agnihothrudu (1957 b), Riviere (1959), Rouatt (1959), Katznelson (1961), Parkinson et al., (1963) and Ranga Rao (1971), Where they have also reported that the rhizosphere effect increases with age of the plant and reaches a maximum coincident with its greatest vegetative development. However, a further increase during senescens was also reported by Gujrati (1969). At the stage of highest vegetative growth of the plant, the rhizosphere soil is biologically more active supporting larger microbial population than the corresponding non-rhizosphere soil. Increase in fungal population during senescens may partly be attributed to decaying roots of the plants and the substantial increase of the sloughed off root material in the rhizosphere. By and large, the frequency of most of the fungi increases in the rhizosphere and rhizoplane of uninoculated plants with the increase in age of the plant. However, in the inoculated plants, the frequency of most of the parasitic forms increases with the age and saprophytic forms decreases (Tables 4 & 5). The frequency of saprophytic forms has been higher in the rhizosphere and rhizoplane of uninoculated plants in comparison to their inoculated counterparts. However, in the inoculated plants, the frequency of parasitic fungi has been higher in comparison to uninoculated plants. This indicates that in the rhizosphere and rhizoplane of uninoculated plants saprophytic fungi form the dominant flora; however, in the inoculated plants parasitic forms, particularly *Fusarium udum*. The frequency of *Fusarium udum* in the rhizosphere and rhizoplane increases with the age of the plant and slightly declines at senescens (Tables 4 & 5). The inoculation of *Fusarium udum* brings about the suppression of saprophytic forms. However, the parasitic forms have been encouraged. Upadhyay and Rai (1978 & 1982) and Rai and Upadhyay (1983) also demonstrated the ability of *Fusarium udum* to suppress other fungi in the rhizosphere and rhizoplane of pigeon pea. They also observed that *Fusarium udum* is a strong saprophytic colonizer of pigeon pea and has high competitive saprophytic colonization (CSC) ability.

The rhizosphere mycoflora of uninoculated plants and non-rhizosphere exhibit qualitative differences. Fungi viz., *Circinella tenella*, *Aspergillus funiculosus*, *A. sulphureus*,

A. candidus, A. terricola, Neocosmospora vasinfecta, Cephalosporium roseo-griseum, Gelasinospora cerealis and black sterile mycelium have been reported from the rhizosphere of uninoculated plants and not from the non-rhizosphere; Mortierella alpina, Pyrenochaeta cajani, Monilia brunnea, Rhizoctonia solani and white sterile mycelium from the non-rhizosphere but not from the rhizosphere of uninoculated plants. It has been reported that root exudates have a distinct selective action on the rhizosphere microorganisms which results in the stimulation of certain groups and suppression of the others (Lochhead, 1940). Qualitative differences between the rhizosphere and non-rhizosphere mycoflora have also been reported by Chester and Parkinson (1959), Peterson (1958 & 1959), Catska et al.,(1960), Papavizas and Davey (1961), Goos and Timonin (1962) and Singh (1971). Qualitative differences have also been observed in the rhizosphere mycoflora of uninoculated and inoculated plants. Circinella tenella, Aspergillus luchuensis, A. sulphureus, Neocosmospora vasinfecta, Cephalosporium curtipes, C. asperum, Gelasinospora cerealis, Trichoderma viride, Fusidium viride, and black sterile mycelium have been reported only from uninoculated plants and Cunninghamella echinulata, Mortierella alpina, Aspergillus candidus, Pyrenochaeta cajani, Monosporium olivaceum, Fusarium udum, Rhizoctonia solani and yellow sterile mycelium only from inoculated plants. In the beginning, infections by the pathogen induce changes in chemical composition of the host which might be advantageous to some fungi and disadvantageous to others. Higher concentrations of amino acids, phenols, o-dihydroxy phenols and sugars have been found in the inoculated plant roots in comparison to uninoculated counterparts (Table 2). However, no qualitative differences in amino acids have been noticed in both uninoculated and inoculated plants (Table 3). Changes in amino acid and sugar contents of healthy and diseased roots have been reported by Singh et al. (1978). Qualitative differences in the diseased and healthy plants of pigeon pea have also been reported by (Timonin, 1966; Rai and Upadhyay, 1980). There have also been qualitative differences in the rhizosphere and rhizoplane mycoflora of uninoculated and inoculated plants at different ages. Aspergillus fumigatus, A. flavus and Curvularia pallescens in the rhizosphere and A. fumigatus, A. flavus and A. niger in the rhizoplane have been recorded from both uninoculated and inoculated plants at all age intervals. Aspergillus sulphureus in the rhizosphere and Circinella tenella, A. sulphureus, Cephalosporium curtipes, C. roseo-griseum, Trichoderma viride and T. album in the rhizoplane have been detected at all age intervals in uninoculated plants only. In the inoculated plants, on the other hand, *Mucor racemosus*, *Cunninghamella echinulata*, *Monosporium olivaceum* and *Fusarium udum* in the rhizosphere and *M. racemosus*, *C. echinulata* and *F. udum* in the rhizoplane have been recorded at all age intervals. *Aspergilli* constitute the dominant flora of the rhizosphere and rhizoplane of uninoculated plants of pigeon pea. This is in agreement with Agnithothrudu (1953) who worked on the rhizosphere of sorghum, cotton, french bean and pigeon pea. However, in the inoculated plants of pigeon pea, *Fusarium udum* and other parasitic fungi constitute the dominant flora. This is in conformity with Rai and Upadhyay (1980). According to Scroth and Hildebrand (1964), Katznelson (1965) and Rovira (1965), rhizosphere microflora is affected by the age of the plant, probably due to the quantitative and qualitative changes in the root exudates. Quantitative changes in the concentrations of total free amino acids, phenols, o-dihydroxy phenols and sugars have been observed in the roots of both uninoculated and inoculated plants with the increase in age of the plant. Concentrations of total free amino acids, phenols, o-dihydroxy phenols and sugars increase upto 90 days old plant and decline upto 180 days old plants and further increase in case of free amino acids, phenols and o-dihydroxy phenols. There has not been any increase in sugars after 90 days in both uninoculated and inoculated plants. Inoculation of

Fusarium udum increases the concentration of all the chemicals at all age intervals. Dimond (1970) also concluded that wilt pathogens brought about biochemical changes in the host plant which are pathogen as well as host origin.

The rhizosphere and rhizoplane mycoflora of different cultivars of pigeon pea uninoculated and inoculated with Fusarium udum have similarities and also differences in quality and quantity. Certain forms like - Aspergillus fumigatus, A. flavus, A. niger, Phoma hibernica, Chaetomium magnum, Drechslera australiensis, Curvularia pallescens and Cladosporium herbarum have been recorded from all the cultivars in the rhizosphere and rhizoplane of both uninoculated and inoculated plants. However, certain forms have been restricted to certain cultivars in uninoculated and inoculated plants viz., Rhizopus nigricans ICPL-227 and ICPL-42; R. arrhizus Pant A-10; Mortierella alpina T-21 and No. 148; Aspergillus funiculosus T-21 and ICPL-227; and Chaetomium flavum Pant A-10 and ICPL-42 in the rhizosphere; and R. nigricans ICPL-227, ICPL-42, BDN-1, and BDN-2; and C. flavum Pant A-10 and ICPL-42 in the rhizoplane. In the uninoculated plants Aspergillus terreus, Fusidium viride and black sterile mycelium have been isolated from all the cultivars in the rhizosphere and A. terreus and black sterile mycelium in the rhizoplane. However, in the rhizosphere of uninoculated plants Syncephalastrum racemosum has been confined to BDN-1 and BDN-2; *Aspergillus luchuensis* T-21, No. 148 and ICPL-227; *A. nidulans* T-21 and ICPL-227; *A. sulphureus* No. 148, Pant A-10, ICPL-227 and ICPL-42; *A. ochraceous* ICPL-227 and ICPL-42; *A. sydowi* DL-78-2 and BDN-1; *Penicillium chrysogenum* BDN-1; *Neocosmospora vasinfecta* T-21, Pant A-10 and DL-78-2; and *Trichoderma album* No. 148, BDN-1 and BDN-2; and in the rhizoplane *A. sulphureus* No. 148, Pant A-10, ICPL-227 and ICPL-42; and *N. vasinfecta* T-21, Pant A-10 and DL-78-2. In the inoculated plants *Cunninghamella echinulata*, *Fusarium udum*, *Alternaria alternata*, *Helminthosporium sativum* and *Sclerotium rolfsii* have been detected from all the cultivars in the rhizosphere and rhizoplane. However, certain forms have been restricted to certain cultivars viz., *Mucor racemosus* T-21; *Curvularia geniculata* ICPL-42 and DL-78-2; *Nigrospora sphaerica* No. 148, Pant A-10, ICPL-42 and DL-78-2; *Cormiscium stilbosporum* ICPL-227, ICPL-42 and BDN-1, *Torula allii* No. 148, ICPL-227 and DL-78-2; *Rhizoctonia solani* T-21 and ICPL-227, ICPL-42 and BDN-1 in the rhizosphere; and *M. mucedo* ICPL-42, DL-78-2, BDN-1 and BDN-2; *M. racemosus* T-21; and *R. solani* T-21, ICPL-227 and ICPL-42 in the rhizoplane.

Different pigeon pea cultivars differ in their rhizosphere fungal population. Highest fungal population has been recorded in the cultivar T-21 and lowest in BDN-1 in both uninoculated and inoculated plants. Higher fungal population has been recorded in the rhizosphere of inoculated plants in comparison to uninoculated counterparts in all the cultivars (Table 6). Highest frequency has been recorded for *Aspergillus fumigatus* in the rhizosphere and rhizoplane among all the cultivars in uninoculated plants. In inoculated plants, on the other hand, highest frequency has been noticed for *Fusarium udum* in the rhizosphere and rhizoplane among all the cultivars except BDN-1 and BDN-2, where it has been for *Aspergillus fumigatus*. The frequency of saprophytic fungi has been higher in the rhizosphere and rhizoplane of uninoculated plants in comparison, to their inoculated counterparts (Tables 8 & 9). On the other hand, in the inoculated plants, the frequency of parasitic forms has been higher in comparison to uninoculated plants. In the uninoculated plants majority of the saprophytic fungi exhibit higher frequency in comparison to parasitic forms in all the cultivars. However, reverse has been true in the inoculated plants in all the cultivars except BDN-1 and BDN-2. The frequency of *Fusarium udum* has been highest in the rhizosphere and rhizoplane of T-21 followed by cultivars No.148, DL-78-2, ICPL-42, ICPL-227, Pant A-10, BDN-1 and BDN-2. In the rhizosphere and rhizoplane of uninoculated plants saprophytic fungi constitute the dominant flora among all the cultivars. Saprophytic fungi have been most dominant in cultivars BDN-1 and BDN-2 and least among T-21 and No. 148. This probably could be one of the the reasons of high frequency of *Fusarium* udum in cultivars T-21 and No. 148 and low frequency in BDN-1 and BDN-2. Fusarium udum has been able to establish in all the cultivars when inoculated around the roots. After inoculation, Fusarium udum has been able to alter the rhizosphere and and rhizoplane mycoflora by suppressing saprophytic fungi and favouring parasitic forms; however, in the cultivars BDN-1 and BDN-2, the suppression of saprophytic forms has been least as a result the saprophytic forms dominated in comparison to parasitic forms. Quantitative estimations of roots of uninoculated and incoulated plants of all the cultivars reveal the higher concentrations of total free amino acids, phenols, o-dihydroxy phenols and sugars in inoculated plants of all the cultivars in comparison to their uninoculated counterparts. It has also been observed that cultivars which harbour higher number of fungi and have higher frequency of Fusarium udum in the rhizosphere and rhizoplane in comparison to other cultivars have low concentrations of total amino acids, phenols, o-dihydroxy phenols but higher concentration of sugars. On the other hand, cultivars which possess lower number of fungi and lower frequency of Fusarium udum in the rhizosphere and rhizoplane have higher concentrations of total free amino acids, phenols, O-dihydroxy phenols and lower concentrations of sugars in their roots. Matta et al. (1969) reported that tomato plants inoculated with Fusarium oxysporum f. sp. lycopersici synthesize increased amount of both total phenols and o-dihydroxy phenols. These compounds are produced more rapidly in resistant than susceptible plants. In the present studies also in the cultivars BDN-1 and BDN-2, which have low frequency of Fusarium udum, increase in total and o-dihydroxy phenols has been much more in comparison to other cultivars (Table 7). Qualitative similarity in the mycoflora of different cultivars could possibly be attributed to the common characteristics of the different cultivars and the soil in question (Kamal and Singh, 1969). However, the differences in the qualitative nature of mycoflora may be in part due to preferential stimulation provided by different cultivars which might be dependent upon the nature and amount of their root exudates and sloughed off root materials (Parkinson, 1967; Gangwane, 1972) in addition to other factors.

Investigations on the rhizosphere and rhizoplane mycoflora of uninoculated and inoculated plants of cultivars T-21 and BDN-1 in relation to foliar sprays with growth regulators reveal that indole acetic acid, indole butyric acid, thio-indole butyric acid and gibberellic acid exhibit stimulatory effect on the population of fungi in the rhizosphere of both uninoculated and inoculated plants of both the cultivars; however, maleic hydrazide shows inhibitory effect. Roy and Dwivedi (1967) also reported that foliar spray of some hormones like indole acetic acid and 3-yl-propionic acid resulted in increase in rhizosphere population. Sullia (1968), Gujrati (1969) and Singh (1970) observed that rhizosphere fungal population of gram, leguminous weed and *Argemona maxicana* increased as a result of foliar application of hormones. Gupta (1971) noticed that foliar application of gibberellic acid (50 to 200 ppm) significantly influenced the number of fungi per gram of soil in the rhizosphere of *Datura alba* and *Ocimum sanctum*. Dwivedi and Singh (1971) recorded that foliar spray of 50 ppm concentration of gibberellic acid increased the rhizosphere population; however, 100 and 200 ppm and all concentrations of maleic hydrazide showed inhibitory effect. Inhibitory effect of maleic hydrazide on the population of fungi in the rhizosphere has also been reported by Mishra (1968). On the other hand, Singh (1981) reported some what stimulatory effect of maleic hydrazide. It seems that these chemicals applied to the leaves are translocated downward and are exuded out through roots in the same original form or their metabolic forms, thus altering the nature of root exudates which affect the rhizosphere population of fungi. Higher fungal population has been recorded in the rhizosphere of inoculated plants of both the cultivars in comparison to uninoculated plants. This may partly be attributed to increased root secretions in the inoculated plants. The frequency of majority of fungi increases in the rhizosphere and rhizoplane of uninoculated plants of both the cultivars with the sprays of indole acetic acid, indole butyric acid, thio-indole butyric acid and gibberellic acid and decreases with maleic hydrazide. A similar observation has been made in the inoculated plants of both the cultivars; however, with indole acetic acid, indole butyric acid and thio-indole butyric acid, frequency of some of the saprophytic fungi decreases (Tables 11 to 20). The decrease may be attributed to the increase in the frequency of Fusarium udum along with other parasitic fungi. The frequency of Fusarium udum increases in the rhizosphere and rhizoplane mycoflora of both the cultivars with the spray of indole acetic acid, indole butyric acid, thio-indole butyric acid, gibberellic acid and decreases with maleic hydrazide (Tables 11 to 20). In the rhizosphere and rhizoplane of uninoculated plants of both the cultivars, the majority of saprophytic fungi have higher frequency in comparison to parasitic forms with all the foliar sprays. On the other hand, in the inoculated plants, the frequency of most of the parasitic forms has been higher in comparison to saprophytic forms in the rhizosphere and rhizoplane of T-21 and rhizoplane of BDN-1 in all the treatments except maleic hydrazide (Tables 11 to 20). However, in the rhizosphere of BDN-1 a reverse trend has been found except in indole acetic acid spray.

Foliar sprays with fertilizers reveal that by and large urea exhibits stimulatory effect on the rhizosphere population of uninoculated and inoculated plants of both the cultivars T-21 and BDN-1. On the other hand, spray with potash shows inhibitory effect in the rhizosphere of uninoculated and inoculated plants of cultivar T-21 and inoculated plants of cultivar BDN-1; however, a stimulatory effect in the rhizosphere of uninoculated plants of BDN-1 has been noticed. Ramachandra Reddy (1959 & 1968), Dwivedi and Singh (1971), Rao and Raja (1978) reported a higher rhizosphere population with urea spray.

The frequency of majority of the fungi increases in the rhizosphere and rhizoplane of uninoculated and inoculated plants of both the cultivars with urea. On the other hand, with potash spray, the frequency of majority of saprophytic fungi increases while most of the parasitic forms decreases (Tables 21 to 24). Probably due to this fact, the population of fungi in the rhizosphere of uninoculated and inoculated plants of T-21 and inoculated plants of BDN-1 decreases because the parasitic forms constitute the dominant flora. However, the population of fungi in the rhizosphere of uninoculated plants increases because here the saprophytic fungi constitute the dominant flora. The frequency of Fusarium udum increases with urea; However, decreases with potash spray. Fusarium udum has been completely eliminated with potash spray in the rhizosphere and rhizoplane of BDN-1 after II and III spray. The changes in the rhizosphere population and frequency of fungi as a result of spray of urea may partly be due to the fact that urea when sprayed is probably absorbed by the leaves and metabolised (Thorne, 1954; Boynton, 1954) resulting in more proteins and amino acid which on exudation might affect the rhizosphere mycoflora. Potash might also be absorbed by leaves and metabolised resulting in such substances which on exudation might influence the rhizosphere flora. In the rhizosphere and rhizoplane of uninoculated plants of both the cultivars, the frequency of most of the saprophytic forms has been higher in comparison to parasitic forms with urea and potash spray and only with potash spray in inoculated plants. However, a reverse trend has been observed with urea in the rhizosphere and rhizoplane of inoculated plants.

Studies on foliar sprays with pesticides reveal that by and large foliar sprays of bavistin, vitavax, brassicol, benlate, fytolan, captan, wettable sulphur and 2,4-dichlorophenoxy acetic acid show inhibitory effect on the rhizosphere population of uninoculated and inoculated plants of both the cultivars. However, streptomycin spray shows stimulatory effect. Halleck and Cochrane (1950), Sullia (1969), Srivastava and Mishra (1971), Balsubramanian and Rangaswami (1973) and Srivastava and Dayal (1981) also recorded inhibitory effect of different fungicides on the rhizosphere population. Gupta (1974) reported stimulatory effect on the rhizosphere fungal population due to foliar spray of an antibiotic subamycin (a tetracycline compound). The frequency of majority of the fungi decreases with foliar spray of bavistin, vitavax, brassicol, benlate, fytolan, captan, wettable sulphur and 2,4-dichlorophenoxyacetic acid in the rhizosphere and rhizoplane of uninoculated plants of both the cultivars; however, with wettable sulphur, the frequency of some of the parasitic forms increases. With streptomycin most of the fungi exhibit an increase in the frequency. In the rhizosphere and rhizoplane of inoculated plants, the frequency of most of the saprophytic fungi increases while parasitic fungi decreases with bavistin, vitavax, brassicol, benlate and fytolan (Tables 25 to 34). A similar pattern has been observed in the rhizoplane of T-21 with captan and wettable sulphur . The increase in the frequency of saprophytic fungi may partly be due to the decrease in the frequency of Fusarium udum and other parasitic forms. A different situation arises in the rhizosphere of T-21 with captan and wettable sulphur, where the frequency of majority of the saprophytic forms along with some parasitic forms increases while the remaining parasitic ones decreases. In the rhizosphere and rhizoplane of BDN-1 a reverse trend has been noticed. It is possible that captan and wettable sulphur might not be effective against those fungi exhibiting higher frequency along with other factors. The frequency of most of the fungi decreases with

2,4-dichlorophenoxy acetic acid in the rhizosphere and rhizoplane of inoculated plants of both the cultivars; however, with streptomycin the frequency of majority of the fungi increases (Table 39 to 42). The frequency of Fusarium udum decreases in all the sprays in the rhizosphere and rhizoplane of both the cultivars except with streptomycin where the frequency increases. Fusarium udum has been completely eliminated in the rhizosphere of BDN-1 with bavistin, 2,4-dichlorophenoxyacetic acid after III spray, in the rhizoplane of BDN-1 with bavistin after II spray and with vitavax after III spray (Table 25, 26, 28 & 39). Balsubramanian and Rangaswami (1973) observed that application of fungicide reduced amino acid exudation, caused qualitative changes in sugars and considerably reduced the rhizosphere population. Same may be operative in the present study also. Increase in rhizosphere fungal population due to streptomycin spray may probably be assigned to the fact that the spray stimulates the plant to produce certain substances that are exuded from roots (Gupta, 1974) and thus alter the root exudation and fungal population (Vrany et al., 1962). In the rhizosphere and rhizoplane of uninoculated plants, majority of the saprophytic forms exhibit higher frequency in comparison to parasitic forms in all the treatments. A similar trend has been observed in the rhizosphere and rhizoplane of inoculated plants of both the cultivars with bavistin, vitavax, brassicol, benlate and fytolan; with captan and wettable sulphur in cultivar T-21; with 2,4-dichlorophenoxyacetic acid and streptomycin in BDN-1. However, a reverse trend has been observed in the cultivar T-21 with 2,4-dichlorophenoxyacetic acid and streptomycin; in cultivar BDN-1 with captan and wettable sulphur.

Studies on non-rhizosphere, rhizosphere and rhizoplane in relation to different soil amendments indicate that in the rhizosphere and rhizoplane of both the cultivars T-21 and BDN-1 and in the non-rhizosphere amendments with urea, superphosphate, potash, neem cake, groundnut cake, castor cake and mustard cake show stimulatory effect; however, mahua cake, bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur somewhat inhibitory. Stimulatory effect has also been noticed in the rhizosphere and rhizoplane of inoculated plants of both the cultivars with urea and superphosphate, however, rest of the treatments show inhibitory effect. The frequency of most of the saprophytic fungi in the rhizosphere and rhizoplane of uninoculated plants of both the cultivars and in the non-rhizosphere increases in treatments with urea, superphosphate, potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake and decreases in all the fungicidal treatments; however, most of the parasitic fungi increase with urea and superphosphate and decrease in rest of the treatments. In the rhizosphere and rhizoplane of inoculated plants of cultivar T-21, the frequency of most of the saprophytic fungi increases in all the treatments; however, in case of BDN-1, the frequency increases in the treatments with urea, superphosphate, potash and oil cakes and either increases or decreases in the fungicidal treatments. On the other hand, the frequency of majority of parasitic fungi increases with urea and superphosphate and decreases in rest of the treatments in both the cultivars. In the rhizosphere and rhizoplane of T-21, *Fusarium udum* has been completely eliminated in treatments with neem cake, mahua cake, castor cake, bavistin, vitavax and benlate. In the rhizosphere and rhizoplane of BDN-1, *Fusarium udum* has been completely controlled in treatments with potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, brassicol, benlate and fytolan (Tables 45 to 48). The saprophytic fungi exhibit higher frequency in comparison to parasitic forms in all the treatments in the rhizosphere and rhizoplane of uninoculated plants of T-21; however, in inoculated plants a reverse trend has been noticed in only urea and superphosphate. Similarly, in the rhizosphere and rhizoplane of uninoculated plants of cultivar BDN-1, the frequency of majority of saprophytic forms has been higher in comparison to parasitic forms; however, in inoculated plants superphosphate has been exception where reverse trend has been observed. Mosolov *et al.* (1959) and Jalaluddin (1975) reported stimulatory effect of inorganic fertilisers on the non-rhizosphere and rhizosphere population. Inorganic fertilizers may induce fresh root formation and increase root exudation in the plants and thus may provide more substrate for rhizosphere and rhizoplane microorganisms resulting in more population and higher frequency of these organisms. In the inoculated plants *Fusarium udum* has been favoured by urea and superphosphate treatments. Although potash treatment has suppressed most of the parasitic forms resulting in stimulation of majority of the saprophytic forms in both uninoculated and inoculated plants. Papendick and Cook (1974) reported that *Fusarium* crown and foot rot was favoured by large amount of nitrogen. Mc Rae and Shaw (1933) observed that superphosphate increased pigeon pea wilt and also favoured the growth of pathogen *in vitro*. Rai and Upadhyay (1983) reported that competitive saprophytic colonization (CSC) of *Fusarium udum* was promoted by urea amendments. Lewis (1979) and Huber (1979) observed that high amount of potassium in soil was correlated with disease suppression or decline in population of several pathogens. Bruehl (1975) and Papavizas (1974) summarized many reports in which decrease in disease or pathogen survival was attributed to an increase in specific or general microbial activity. The increased microbial activity may result in nutrient competition, mycoparasitism or production of toxic materials (Merriman, 1976; Papavizas, 1974).

Oil cakes, the product left after extraction of oils, contain sufficiently higher concentration of lignin, cellulose and other carbohydrates, certain nitrogenous materials etc. which are suitable for all types of colonizers, thus resulting in the increase of fungal population, particularly saprobes. Kirmani (1977) has also reported that oil cakes during decomposition in the soil are colonized by primary as well as secondary and tertiary colonizers. The reduction in the frequency of parasitic forms might probably be due to release of toxic materials during decomposition which are fungistatic or fungicidal. The possibility that oil cakes and other amendments which are a source of nitrogen to crop plants, provide better plant growth together with more root exudates and more host surface for fungal activity can not be ruled out. Upadhyay and Rai (1981) were of the opinion that soil amendments may leave either determintal effect on the pathogen or may change the biological balance of soil in favour of antagonists, which would ultimately suppress the pathogen. In the present studies the frequency of _Trichoderma viride_ and other saprophytic forms substantially increases with oil cake amendments in the rhizosphere and rhizoplane of both the cultivars. Therefore, the part played by *Trichoderma viride* and other saprophytic forms as antagonists in suppressing the wilt pathogen *Fusarium udum* in the present investigation cannot be ruled out.) Evans (1955) and Saksena (1960) also reported that high population of *Trichoderma* may suppress pathogen. The inhibitory effect of filtrates of certain saprophytic forms such as *Aspergillus terreus*, *A. niger* and mixed filtrates of different soil fungi against *Fusarium udum* on solid media was shown by Vasudeva and Roy (1950) and Vasudeva and Govindaswami (1953). Rai and Upadhyay (1983) observed that colonization of *Fusarium udum* on pigeon pea substrate was suppressed by saprophytic forms when present in inoculum mixture with *F. udum* or when substrate had already been colonized by them. Inhibitory effects on soil microorganisms as a result of application of nematicides, pesticides and herbicides have been reported by Bollen *et al.* (1954), Bollen (1961), Lebed (1964), Tu (1972 & 1973), Singh and Prasad (1973), Midha and Nandwana (1974), Rodriguez-Kabana and Adams (1975) and Jain and Sehgal (1980). Vaartaja and Agnihotri (1970) observed that with methyl bromide and captan the pathogenic fungi decreased and saprophytic forms increased in the rhizosphere of spruce. Bertoldi *et al.*, (1977 & 1978) recorded inhibition of rhizosphere fungi with captan and benomyl.

In vitro, *Fusarium udum* has been inhibited by several systemic fungicides (Ghosh and Sinha, 1981). Sinha (1975), Haider *et al.*

(1978) and Upadhyay and Rai (1981) observed that application of many systemic fungicides in soil controlled the wilt disease of pigeon pea. Bavistin completely controlled the wilt disease. The decrease in frequency of parasitic forms with the amendments of fungicides may probably be attributed to decrease in competitive saprophytic colonization (CSC) of these parasitic forms (Rai and Upadhyay, 1983).

In the present studies age and different cultivars have been found to influence the rhizosphere and rhizoplane mycoflora of both uninoculated and inoculated plants of pigeon pea. The frequency of Fusarium udum increases in the rhizosphere and rhizoplane with the age of the plant and slightly declines at senescens. Different cultivars exhibit different frequency of Fusarium udum. Foliar sprays with growth regulators, fertilizers and pesticides and soil amendments with fertilizers, oil cakes and fungicides have brought about significant changes in the rhizosphere and rhizoplane mycoflora of both the cultivars T-21 and BDN-1. With the foliar spray of indole acetic acid, indole butyric acid, thio-indole butyric acid, gibberellic acid, urea and streptomycin, the frequency of Fusarium udum increases in the rhizosphere and rhizoplane of both the cultivars and decreases with sprays of maleic hydrazide, potash, bavistin, vitavax, brassicol, benlate, fytolan, captan, wettable sulphur and 2,4-dichlorophenoxyacetic acid. Fusarium udum has been completely eliminated in the rhizosphere of BDN-1 with bavistin, 2,4-dichloroxyacetic acid after III spray; in the rhizoplane with bavistin after II and with vitavax after III spray. The frequency of Fusarium udum decreases with all the soil amendments except urea and superphosphate in the rhizosphere and rhizoplane of both the cultivars. Fusarium udum has been completely controlled in the rhizosphere and rhizoplane of T-21 with neem cake, mahua cake, castor cake, bavistin, vitavax, benlate and in the rhizosphere and rhizoplane of BDN-1 with potash, neem cake, ground nut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, brassicol, benlate and fytolan. The frequency of saprophytic forms has been found to increase with the decrease in the parasitic forms particularly Fusarium udum in all oil cake amendments. Moreover, the freuqncy of Trichoderma viride also substantially increases in oil cake amendments indicating the part played by antagonists in suppressing pathogens. The present studies would, therefore, go a long way in exploring and envisaging different possibilities where the rhizosphere mycoflora could be modified by folair applications and soil amendments for control of root diseases. Brian (1957) also mentioned that successful control of root diseases probably lies in the development of satisfactory methods for influencing the rhizosphere microflora.

SUMMARY

1. Rhizosphere of uninoculated and inoculated plants of pigeon pea with <u>Fusarium udum</u> harboured more fungal population in comparison to non-rhizosphere. Moreover, higher fungal population was encountered in the rhizosphere of inoculated plants in comparison to their uninoculated counterparts.

2. Age profoundly influenced the rhizosphere population, R:S ratio and the frequency of fungi in the rhizosphere and rhizoplane of both uninoculated and inoculated plants of pigeon pea. Fungal population and R:S ratio fluctuated with age of the plants. The first peak of population was recorded during highest vegetative growth of the plants i.e. 90 days old plants and the second peak at the senescens i.e. 240 days old plants, in both uninoculated and inoculated plants. Highest R:S ratio was noticed, in both uninoculated and inoculated plants, at the senescens. The frequency of <u>Fusarium udum</u> increased with an increase in age of the plants and attained maximum value in 120 to 180 days old plants and slightly decreased at the senescens. The biochemical composition of roots of uninoculated and inoculated plants also showed variation with age. Higher concentrations of total free aminoacids,

phenols, o-dihydroxyphenols and sugars were found in the roots of inoculated plants in comparison to their uninoculated counterparts at all age intervals. Qualitative differences were observed in the mycoflora of rhizosphere of uninoculated and inoculated plants and non-rhizosphere. Qualitative nature of the rhizosphere and rhizoplane mycoflora of uninoculated and inoculated plants differed with the age of the plants.

3. The rhizosphere and rhizoplane mycoflora of different pigeon pea cultivars uninoculated and inoculated with Fusarium udum showed differences in quantity and quality. Higher fungal population was noticed in the rhizosphere of inoculated plants of all the cultivars in comparison to their uninoculated counterparts. Highest fungal population was recorded in the cultivar T-21 and lowest in BDN-1 in both uninoculated and inoculated plants. The biochemical nature of roots of both uninoculated and inoculated plants of different cultivars differed quantitatively. Higher concentrations of total free amino acids, phenols, o-dihydroxy phenols were recorded in the roots of inoculated plants in comparison to their uninoculated counterparts in all the cultivars. The frequency of Fusarium udum was highest in T-21 and lowest in BDN-1.

4. Indole acetic acid, indole butyric acid, thio-indole butyric acid, gibberellic acid, urea and streptomycin, when applied as foliar sprays, showed stimulatory effect on the rhizosphere and rhizoplane mycoflora of uninoculated and inoculated plants of both the cultivars T-21 and BDN-1; however, sprays with maleic hydrazide, potash, bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur and 2,4-dichlorophenoxyacetic acid exhibited inhibitory effects except potash in uninoculated plants of cultivar BDN-1. The frequency of Fusarium udum increased in the rhizosphere and rhizoplane with the sprays of indole acetic acid, indole butyric acid, thio-indole butyric acid, gibberellic acid, urea and streptomycin and decreased with maleic hydrazide potash, bavistin, vitavax, brassicol, benlate, fytolan, captan, wettable sulphur and 2,4-dichlorophenoxyacetic acid. Fusarium udum was completely eliminated in the rhizosphere of BDN-1 with bavistin, 2,4-dichlorophenoxyacetic acid after III spray and in the rhizoplane with bavistin after II; with vitavax after III spray.

5. Application of urea, superphosphate, potash, neem cake, groundnut cake, castor cake and mustard cake as soil amendments showed stimulatory effect on the rhizosphere and rhizoplane mycoflora of both the cultivars T-21 and

BDN-1 of uninoculated plants; however, mahua cake, bavistin, vitavax, brassicol, benlate, fytolan, captan and wettable sulphur showed some what inhibitory effect. Stimulatory effect was also noticed in the rhizosphere and rhizoplane of inoculated plants of both the cultivars with urea and superphosphate, however, rest of the treatments showed inhibitory effect. The frequency of Fusarium udum increased in amendments with urea and superphosphate and decreased in rest of the treatments. In the rhizosphere and rhizoplane of cultivar T-21, Fusarium udum was completely eliminated with neem cake, mahua cake, castor cake, bavistin, vitavax and benlate; and with potash, neem cake, groundnut cake, mahua cake, castor cake, mustard cake, bavistin, vitavax, brassicol benlate and fytolan in the rhizosphere and rhizoplane of BDN-1.

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*Original not seen.